THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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CHEAP POWER FOR LONDON.

ON Thursday night last week, after all the influence and pressure that could be brought to bear for and against the Bill of the Administrative County of London and District Electric Power Co. had been exerted, and after three hours' discussion, the Bill was read a second time by a majority of 40. Strenuous efforts were made by the champions of municipal trading and the existing companies, led by Mr. Burns and Mr. Cripps respectively, to quash the Bill, which was supported by Mr. Bousfield and Mr. Bonar Law; but the case for the Bill was too strong. Indeed, after the masterly exposition of the facts by Mr. Bonar Law, on behalf of the Board of Trade, it is difficult to imagine any other outcome of the contest; the mere fact that the Board of Trade vigorously supported the Bill was a most powerful argument in its favour, for the single-minded zeal of the Board in the public service, and its absolute honesty of purpose, irrespective of party or person, are beyond question or dispute. The Bill now goes before a Committee, where the opponents of the measure will have full opportunity of stating their case.

Considering the whole question from an impartial standpoint, one is confronted with two main considerations:—First, that cheap electrical energy for motive power is not merely desirable, but a necessity, and must be supplied, by whatever authority. In this connection it is noteworthy that there is over half a million horse-power at work in London factories and workshops, not 5 per cent. of which is supplied by electrical means. Secondly, the existing companies, which have been amongst the world's pioneers in electricity supply, and have developed their undertakings in the face of innumerable obstacles, are subject to severe restrictions, especially in regard to the limitation of their areas of supply, and the imposition of a clause rendering their undertakings liable to purchase by local authorities at the end of a comparatively brief term of years. These companies, therefore, are entitled to adequate and effective protection against unrestricted and consequently unfair competition.

It is greatly to be regretted that a campaign of falsehood and misrepresentation should have been carried on against the new company's proposals. It has been repeatedly shown that, unless the average price obtained by the company for energy does not exceed ¾d. per unit, it cannot pay its dividend; yet it has been stated again and again by its opponents that the company seeks to establish a monopoly which will enable it to charge whatever it likes. It has been suggested that the existing companies will eventually amalgamate with it, and thus share in the monopoly; but we must confess that a monopoly compelled by Statute to supply electrical energy at an average price of ¾d. would, in our opinion, be a most beneficent undertaking, a factor of the first importance in the prosperity of London and the welfare of its inhabitants. If the County Council

had obtained the monopoly of electricity supply after which it hankered, would it—could it—have dared to hint at such a price?

Again, it is urged that the company will pick and choose its areas of supply, rejecting the lean districts and gorging the fat; yet it has been most explicitly laid down that if the company enter an area of supply at all, it shall *ipso facto* be compelled to undertake exactly the same obligations to supply all comers, in *all* parts of that area, as are imposed upon the existing supply authority in the said area. Moreover, the supply authority can itself demand a supply of electrical energy from the company, at rates which will enable it to supply ordinary customers at a reasonable profit—that reasonable profit being determined by the Board of Trade. In the remote contingency of the existing company or local authority being able to supply as cheaply as the new company, the latter is absolutely debarred from coming into the area of supply at all!

As for the demand for electrical motive power, as Mr. Bonar Law clearly pointed out, London as a manufacturing town is of greater importance than any other town in the kingdom; and in London there are innumerable small factories, precisely the kind which cannot generate power cheaply for themselves, and which would most readily become consumers, were it possible to obtain cheap power. Coal and land are excessively dear in London, whereas no other large city in the world offers equal possibilities of generating electrical energy cheaply; and that it can be generated cheaply was conclusively established before the Committee of the House of Lords. Over 250 London firms, employing 100,000 men, and therefore representing 500,000 persons directly, and a very much greater number indirectly, petitioned the House of Lords and the Board of Trade in favour of the Bill. Only half of the London Borough Councils are opposing the Bill; some are actively supporting it, and seeking bulk supply. Some are arguing that the cheap competition will be their ruin, whilst others urge that they can supply as cheaply as the company, and St. Pancras and Hackney are lowering their prices already. Others again say that the power cannot be supplied cheaply!

It is impossible to deny that in London there is an immense opening for the supply of electrical motive power; but the existing authorities are mainly concerned with lighting, a business which the new company cannot touch. Moreover, so far as the companies are concerned, their interests lie mainly in the West End, where there is no great demand for motive power. It is in the East End that the factories are found, and until recently the supply in this quarter has been absolutely inadequate, being mainly in the hands of local authorities, whose prices are far above those proposed by the company. The large railway, dock and steamship companies, like the manufacturers above cited, are supporting the company, and so is the County Council of Essex. The Borough Council of Stepney, which possesses its own electricity works, is numbered amongst the company's supporters.

The financial standing of the promoters, and their ability to carry out their proposals, have been admitted by the House of Lords Committee.

To conclude, we are convinced that, provided the interests of the existing companies are adequately and securely safeguarded, it will be of the greatest advantage to the public in and around London that this great project be authorised by Parliament, and power made available to all at lower rates than are charged in any large city in the world.

Tramway Use-factor.

The current number of the *Light Railway and Tramway Journal* contains an editorialette, which touches a spot of interest to all tramway undertakers.

In almost every tramway or light railway order, provision is made for running municipal services over the lines at night. For instance, the collection of refuse is permitted to a municipal authority in whose area the tramways are run by a company, and naturally a local authority secures the same rights when retaining the tramways in its own hands.

Orders do not limit, as a rule, the hours of running, so that an all-night service, whether it be for freight or passengers, is more a question of expediency than of law. Popular opinion has limited hours of running in certain towns, especially on Sundays, and popular opinion might prevent at any time the all-night running of cars; but, so long as the work that has to be done is done without unreasonable disturbance of the essential quiet of the night, there is not much reason to anticipate popular outcry.

Frontagers soon "got used" to street noises, which in so many cases include tramway noises, but among which the tramway noises are by no means predominant; and street noises continue with considerable intensity in most towns after the average citizen is a-bed, and recommence long before he recovers consciousness.

Let anyone analyse the sounds that come through his window from the street!

He has said, many a time, "Those beastly trams make such a noise that I can't work or read or sleep!" But let him listen, and he will have to confess that the *continuous* noise is made by the clatter of horses' hoofs and the rattle of heavy springless carts and lorries on the paving, not by the poor innocent trams which are up and by in a fraction of the time taken by a coal cart to get out of hearing.

In many towns that continuous noise has been intensified by the coming of the tramways, if these have been paved with stone, for the vehicles and horses make a greater clatter over the setts than they did over the inferior macadam and mud paving which preceded it. On the other hand, the continuous noise is actually decreased when the tramways are paved with wood in exchange for the noisier material of pre-tramway days.

Similarly, then, when refuse has to be collected at night, not only might it be collected more expeditiously and at less expense, but with less disturbance of the night by electric car than by horse-drawn vehicles, and the *Light Railway and Tramway Journal* argues that the tramway equipment may be used in this and in several other ways during the hours when capital as well as burgesses is sleeping.

Every year sees us becoming more owl-like in our use of the night, and it may be that managers in many towns would find themselves repaid for going carefully into the possibilities which their routes present for making the rails and the rest of the equipment bear fruit for those four to six hours out of the 24 during which they now lie idle and worthless. It may mean small beginnings, and it may mean nothing at all, but it is worth the consideration of every manager. So long as an adequate profit is made, after due provision for replacement, the sooner the rails are worn out the better from a true economical standpoint.

The life of every part of the equipment can be expressed in car-miles, and the sooner those car-miles can profitably be run out, the better for the tramway.

The complete formula of maximum efficiency takes the cars owned into account, and should be as much before the eyes of the manager as that other perfect load factor which the engineer seeks with such admirable persistence; it is—

$$\frac{\text{cars run} \times \text{hours run} \times \text{m.p.h. actual}}{\text{cars owned} \times 24 \times \text{m.p.h. (schedule)}} = 0.$$

FLUE-GAS ANALYSIS.

By F. H. CORSON.

In all central power stations, except those of the smallest size, the principal item in the costs of production of current is undoubtedly the fuel bill, and the price at which electrical energy can be profitably sold, must depend to a great extent upon the economy with which the boiler house is worked.

Much has been written on the subject, and many attempts have been made to account in some way for the very varied results obtained under the several conditions existing in different stations.

The load factor of the output from the feeder bus-bars, and, perhaps in a greater degree, the plant load factor, have some considerable bearing on the amount of coal required, but these do not carry us far in our endeavours to discover a reason for the widely differing fuel bills. We find stations with a poor load factor, but with a very low fuel cost, and again others where the conditions of demand are more even, with

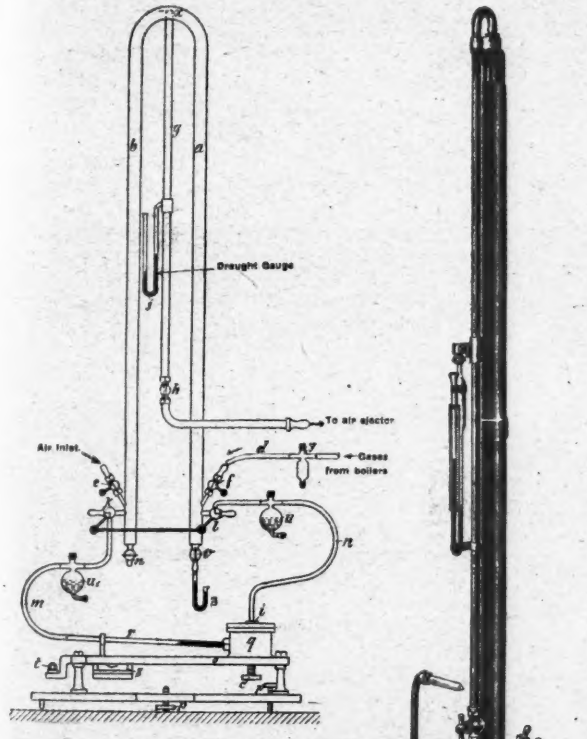


Fig. 1.

Fig. 2.

bad figures in this direction. Condensing must certainly result in economy of steam, but here again we find no law on which to base our calculations. Some condensing stations are using as much as 15 lb. of coal per unit, while others where the plant is run non-condensing, only consume 5 lb. to 6 lb.

The price of fuel delivered at the works is equally unsatisfactory as a basis, and gives little or no help in the inquiry.

It must be presumed, then, that some other agency than those enumerated above, is largely responsible, and the writer is of the opinion that the human element has a good deal to do with the question. The amount and character of the supervision brought to bear on the fuel-consuming department, has an enormous influence on the economic results obtained. In many stations too little attention is paid to the boiler house, and everything is left to the knowledge of a more or less ignorant fireman. Can it be wondered that the expenditure on coal is excessive?

The fireman may be, and often is, a skilful workman as far as his knowledge goes, but the combustion of fuel is a matter demanding treatment of a far higher order of intelligence, than is usually allotted to it. So long as steam pressure is maintained, and smoke avoided, little inquiry is made as to the methods by which these two desirable ends are attained, or as to the cost to the power station at which the steam is supplied.

The writer submits that highly scientific control is essential to good results in the boiler house, and that there is no safety in trusting that the fireman will find out by trial and error that course which entails the least work for himself, and will consequently use the least possible quantity of coal.

It is not an uncommon thing to see firemen clean out fires, charge them heavily with green coal, and then open the fire doors to avoid the heavy smoke which is naturally the result of such a procedure. There is no doubt that the remedy is successful, and that the supply of an enormous excess of air does prevent smoke; but at what cost? The boiler attendant, in the absence of supervision, finds the method effective, judges it to be therefore the right thing, and employs it at almost every time of firing.

The installation of a flue gas analysing apparatus reveals, in boiler houses which are run on apparently economical lines, many points at which improvement can be effected. It is very improbable that in the case of a boiler house where the draught, thickness of fire, and such points are left to the stoker, the proportion of CO_2 in the flue gases will be higher than perhaps 7 per cent. With the furnaces under control, this percentage might easily be increased to 13 or even to 14, with a consequent saving of something like 10 per cent. on the fuel bill.

The apparatus for the analysis of the products of combustion is on the market in various forms. Two types are employed—the one based on the actual absorption of the CO_2 by the action of caustic potash or soda; the other a barometric one, depending on the weight of a column of the flue gas varying in proportion to the amount of CO_2 contained in it. An instrument of this latter class is shown in the illustration (fig. 2), and is the apparatus from which the accompanying charts have been taken.

The action of the analyser is shown by the diagram (fig. 1); *a* and *b* are the two tubes through which air and the gas to be tested, are drawn by the air ejector or pump. At the bottom of each tube is a pipe coupled to the barometer *q*, the liquid in which is raised or depressed in the inclined tube *r*, by increase or reduction in the amount of CO_2 in the flue gases. The inclined tube is graduated and calibrated to read directly in percentages of CO_2; *u* and *u* are reservoirs containing alcohol to ensure the dryness of the gases, and to avoid the deposition of moisture in the tubes of the instrument.

The whole apparatus is provided with levels *s* and *t*, and rests on three adjustable supports. The recording mechanism is simply a camera containing a revolving drum, the position of the liquid in the inclined tube being photographed on the sensitised film carried by this drum, and the record of 24 hours being developed as an ordinary negative.

The first chart shown (fig. 3) was one of the earlier records obtained on a Lancashire boiler burning a fairly low grade Wigan slack. The record, as will be seen, indicated a low percentage of CO_2 showing excess air over that required for combustion. The draught was regulated, the performance of the mechanical stokers improved so as to give a better distribution of fuel over the grate, leakages in the brickwork setting of the boiler were plastered up, and the second chart showing 14 per cent. (fig. 4), was obtained within a fortnight. The sudden drops in the percentage of CO_2, show times of opening the fire doors for the purpose of levelling up the fires, and lifting clinker from bars, or of opening ash pits to withdraw burnt coal. The apparatus

was coupled up to all the boilers in turn, exhibiting similar weaknesses, and calling for similar remedies.

When all possible has been done to effect improvement in the conditions as existing on the individual boilers, it becomes desirable to obtain a record which shall be representative of the whole work of the firemen, and not merely that done on any one boiler. Where the instrument is connected to one boiler, it is a perfectly easy matter for the stoker to find out which, if he has access to the record, and he naturally devotes his energies and attentions to that particular one, often to the neglect of the rest. It is unfortunately impossible to pull the gases from all boiler flues simultaneously by simply opening the cocks together. If this is done, the boiler which carries the least draught either from being banked, or from its distance from the chimney, supplies all the gas for the apparatus, and the other boilers worked under keen draught do not come under test. Assuming, then, that one or two of the boilers are banked, we have those boilers which are doing the least work supplying the test gases for the record.

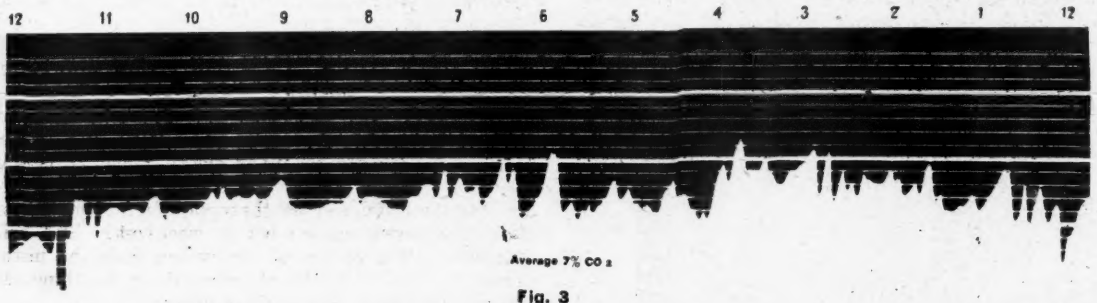


Fig. 3

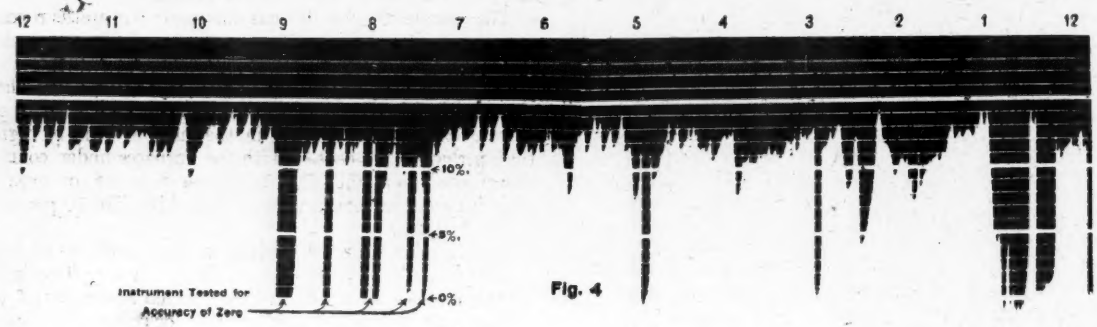


Fig. 4

This method being of no use, the next suggestion is to make one connection to the main flue, but here again difficulties beset the way. By making a series of holes across the main flue and taking simultaneous samples from each, the writer found that the CO_2 percentage varied very widely. The logical deduction from this is that the flue gases from the boilers do not become thoroughly mixed in the main flue. This inference is borne out by the records of some tests made by Mr. Downe at the Southport Electricity Works, and communicated to the Municipal Electrical Association at Sheffield. These tests, carried out with a view of finding the temperature drop in the flues, showed that widely different records were obtained at various points across the flue equally distant from the boilers.

To obtain an accurate idea of the work done, it is of course necessary that the sample gas drawn through the CO_2 instrument should represent the average chemical constitution of all the gas passing at the time.

The swirling action of the gases, induced by some obstruction, such as a damper, or by some sharp change in the direction of flow, would appear to be requisite to the attainment of this desirable uniformity of composition.

On making further tests, the mixing of the gases showed considerable improvement immediately after a right angled turn in the main flue, but the best results were obtained at the outlet end of the economisers, which appeared to complete the operation. A further advantage of taking the sample from the chimney bottom lies in the fact than any leakage of air into the flues or economisers, which might otherwise pass unnoticed, is immediately detected in the lower percentage of CO_2 recorded. Such leaks naturally reduce the temperature of the gases, and affect the draught-producing power of the chimney, necessitating a fairly high exit temperature from the boilers. It is obvious that the lower the final temperature of the gases, other things being equal, the more heat is absorbed by the boiler, and consequently the greater the economy. In the installation of six boilers which was the subject of the experiments here detailed, it was at first found that while maintaining an average of 12 per cent. or 13 per cent. in the boiler side flues, the percentage at economiser outlets had fallen to 6 per cent. Under these conditions the flue gas temperature fell from a mean of 600° F. at exit dampers to about 500° at the economiser inlets. By carefully overhauling all brickwork and dampers, the chimney bottom percentage was raised to 11 per cent., the fall in gas temperature was reduced by 50° F., and it was found possible to lower further the boiler exit temperature while maintaining sufficient draught for the same rate of combustion as had previously existed.

It should be remembered that, at the time of the installation of the gas-testing apparatus, the economy achieved was regarded as fairly satisfactory, and only when the recorder was put to work was it found that the existing state of things was capable of so much improvement.

It is believed that, working on such lines, the engineers of most power plants would be able to effect considerable saving, and that thus a great deal of the discrepancy in the results obtained by plants of similar design, working under similar conditions, would be removed.

SHUNT MOTORS FOR ELECTRIC CRANES.

By CLAUDE W. HILL.

The object of these few notes is to point out the advantages which the shunt motor offers for driving the hoisting gears of cranes, more especially when these gears are remote from the controller.

In driving a hoisting gear we require, whether lifting or lowering and irrespective of the actual load on the hook, to be able to run at a very slow speed for purposes of adjustment and to be able to increase the speed to a maximum which shall vary in some inverse proportion to the load, so that light loads can be lifted more quickly than heavy ones.

With a properly-designed controller, this can to a certain extent be accomplished when lifting with a series motor.

The controller can be designed to give a very slow speed on the first step regardless of the weight on the hook, and the motor, when the controller is full on, will, in a limited

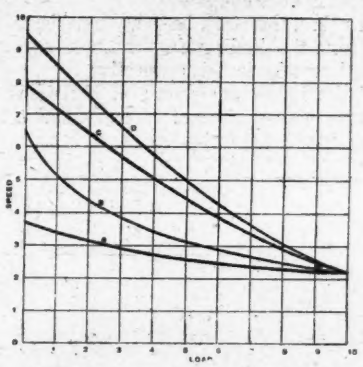


Fig. 1.—Speed and Load Curves.

degree, accommodate its speed to the load. This is shown on the curves A and B, fig. 1. Both of these are taken from actual tests, B representing the best result which the writer has met with.

As the speed range so obtained is insufficient, it is usual to provide change gear giving either two or three speeds.

The changing of these gears, especially in cases where the driver has to walk some distance or climb on to a platform to make the change, is frequently neglected, so that the change gear is of little use.

With a shunt motor the speed can be varied instantly and without trouble, through a wide range, by means of a regulating switch and resistance connected in the magnet circuit and placed close to the driver.

Curves C and D, fig. 1, show the speed-load curves of two cranes equipped with shunt motors and regulated in this manner.

The complete equipment for a shunt motor hoisting gear consists of the motor itself, a plain on and off electro-magnetic brake, a drum controller and a shunt regulating switch placed handy. A circuit-breaker is also advisable.

With this arrangement the controller is so designed that, on the first step, the motor-magnet is always fully excited, irrespective of the position of the shunt regulator, so that on this step a speed as slow as desired is obtained. The controller has contacts corresponding to and connected with the contacts on the shunt regulating switch. As it is moved

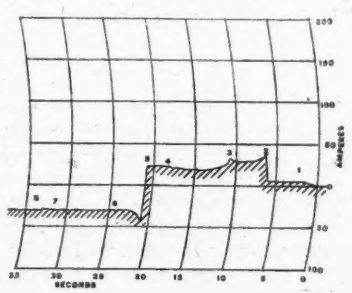


Fig. 2.—Lowering 5 Tons.

over it cuts into the magnet circuit the amount of resistance determined by the position of the shunt regulating switch, so that when the controller is full on, the speed of the motor corresponds to the position of this switch.

For lowering, the series motor is not satisfactory, as, without the assistance of a mechanical brake, it cannot prevent the load running away.

It is when lowering that the shunt motor shows specially to advantage, as, when overhauled by the load, it commences to generate current, and the current so generated not only opposes a torque to the motion of the load sufficient to keep its speed within the limit set by the regulating switch (so saving wear of brakes), but it also feeds the circuit, and so helps to drive other machines.

Fig. 2 is an amperemeter diagram taken on a 5-ton crane on the Cleveland Bridge Co.'s works at Gateshead, showing the flow of current when the controller is put on slowly, step by step, on the lowering side with full load on the hook.

It will be noted that on step 5 the current reverses, and beyond this point there is no change in the current diagram on the succeeding steps of the controller. The speed on the first step is 5 ft. per minute, and on the last step 50 ft. per minute.

Fig. 3 is from the same crane with 1½ tons on the hook. This shows the starting current diagram when the controller is put on in the ordinary way, giving a 3½ sec. start, the current when the load is running down steadily amounting to about 32½ amperes, and the stopping current diagram, when the controller handle is moved back slowly, step by step. The speeds in this case are, first step, about 1½ ft. per minute, and last step about 120 ft. per minute.

Fig. 4 is a slowly taken starting diagram when lowering the hook only. In this case there is no regenerative current, so

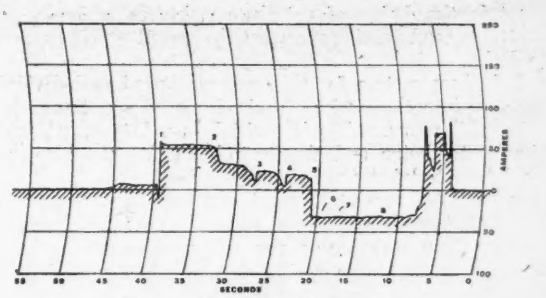


Fig. 3.—Lowering 1½ Tons.

that the shape of the diagram differs from the preceding ones. The speed with hook only is 160 ft. per minute, and when the controller is put on in the ordinary way, a 3½-sec. start is obtained.

On the first step of the controller on the lowering side the magnet winding only is connected to the line, the armature

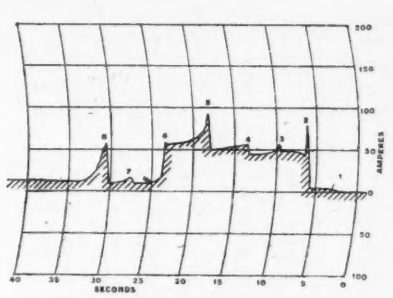


Fig. 4.—Lowering Hook Only.

being short-circuited through a resistance of suitable amount to give the lowest speed required.

The magnet current takes about 1 to 1½ seconds to attain its full value. This slightly retards the acceleration, so that, in cases where full speed has to be attained very quickly, a few turns of series might be added to the magnet coils, the series turns being cut out when the magnet attains its full strength.

Foreign Engineering Enterprise.—A recent visitor to one of the engineering workshops of the Continent states that he found them exceedingly busy, and he especially remarked that in one small detached part of the shop there were a few men experimenting with an oil engine, in another similar space other men were making experiments on a gas engine, and so on. There was every evidence that the firm meant to keep to the front. How much do our home firms expend on experiments? It is certain, he says, that there is considerable evidence of prosperity in the Continental shops. Does not the continual expenditure on experiments account for much of their prosperity? Our own men of means seem to have no fight left in them. They will not experiment, and though there is any amount of capital forthcoming to float obvious swindles, a really good and genuine thing can rarely find support. When such is the case, is it not a proof of the lack of technical knowledge on the part of the men at the head of affairs?

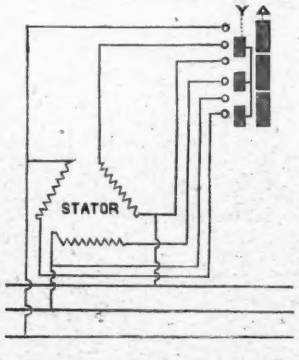
NOTES ON THE WINDING OF POLYPHASE ROTORS.

By LEONARD J. PUMPHREY.

Now that three-phase installations are becoming more and more common in this country, the attention of electrical engineers generally is being turned with augmented interest to the design of polyphase revolving machinery. Our English motor makers are rising to the occasion, one by one, and it is no longer necessary to go abroad to Oerlikon or elsewhere for a reliable induction motor.

It is with the design of windings for three-phase motors, as regarded from the standpoint of one whose time is largely spent in the design of polyphase resistance apparatus for controlling and starting gear, that the present article proposes to deal.

Polyphase motors for this purpose may be sub-divided, broadly, into those with "squirrel cage" and those with "wound" rotors. The "squirrel cage" type, although simpler to design and cheaper to build than the other, has an inherent defect that seriously limits its use in practice. The available starting torque is extremely low, even when switched directly across the mains. The initial rush of current through the stator may, it is true, be limited by the insertion of resistance in the stator winding, but this has the unfortunate effect of still further reducing the torque. One method of overcoming the difficulty to some slight extent is to employ a "delta" connected stator. Starting may then be accomplished with "star" connections, with the aid of a suitably-designed change-over switch, and the subsequent conversion to "delta" is made when the motor has attained a moderate speed, as shown on the accompanying diagram :—



Change-over Starting Device.

Nowadays, "wound" rotors are almost invariably used for ordinary industrial purposes, and it is to these that the writer wishes to draw special attention.

By "wound" rotor, we understand that it is built up of slotted laminations in the ordinary way, wound with an ordinary three-phase winding, and fitted with three slip rings.

It is thus possible to insert external resistance in the rotor circuit, and as the insertion of such resistance enables the motor to develop a large starting torque, the value of the arrangement is at once apparent. As is generally known, an ordinary three-phase starter consists of a lever with three arms arranged so that each arm moves over a series of contacts, thus cutting resistance out of and finally short-circuiting the three phases in the rotor winding.

Now, in an ordinary stationary transformer, the respective voltages across the primary and secondary coils are predetermined by the working conditions. But in an induction motor, which is to all intents and purposes a transformer with a rotating secondary coil, this is not the case, and the primary voltage is alone fixed by the conditions of operation. The fixing of a suitable secondary voltage is thus left to the discretion of the designer; moreover, it will be seen that for, say, a 10-horse motor connected across 250-volt mains (between phases) the design of a suitable starting switch cannot be proceeded with until the pressure and current in the rotor winding are known.

The writer has, therefore, been at considerable pains to collect data from the leading English makers bearing upon their standard practice in this connection.

A few of the figures are shown in the adjoining table. Makers' names are not given, by request, and the different firms are merely referred to by letters.

Maker.	Voltage in rotor (between slip-rings).			
	5 H.P.	10 H.P.	20 H.P.	75 H.P.
A	70	100	120	140
B	90	90	120	275
C	...	220	...	400
D	200	200	200	500
E	30	40	60	100

These figures clearly show that a wide difference of practice exists, and the resulting difficulties experienced by the unfortunate man who wishes to standardise three-phase starting and controlling gear become at once apparent.

Cases frequently arise where two motors of similar horse-power and connected on the same circuit, but of different makes, have rotor currents in the ratio of two to one. The copper required in one set of controlling gear is thus double that of the other, the resistances are of widely different design, and the prices also differ considerably. This is especially the case with controllers of the tramway type. It is thus impossible for the rheostat maker to standardise his apparatus, unless he is prepared to standardise for each horse-power a complete set of gear from which he can pick and choose to accommodate the whims of different designers. To illustrate this point, the writer has only to refer to a recent price list before him.

To fully meet the eccentricities of different designers, it has been found necessary to list starters for rotors with voltages varying from 30 to 400 by gradual increments, and with corresponding increments of current from 10 to 200 amperes. In all there are no fewer than 230 different sizes of starter with corresponding prices, covering a range from ½ to 40 H.P.

This is unsatisfactory from everybody's point of view, and is a continual source of annoyance, fruitless correspondence, and delay.

A suggestion has been made that at some early date it will be possible for motor-makers to come to some agreement amongst themselves as to the most suitable working values. Possibly the Institution of Electrical Engineers will see its way to issue an official recommendation in the matter, which should go a long way towards the standardisation which is becoming every day of more vital importance.

The text-books have very little information bearing upon this point, and it is well that the attention of electrical engineers should be drawn to it, so that opinion on the subject will have an opportunity to mature.

In the meantime, it may be worth while to indicate briefly one or two of the factors that have to be taken into consideration.

From the point of view of cheapness of starting and controlling gear, it is certainly advisable to work with low currents and moderately high voltages. Where female labour can be employed for rotor winding, it is essential to use thin wire, for obvious reasons, and practice shows that it is cheaper to wind thin wires in series than in parallel. This, of course, necessitates high voltages.

On the other hand, where male labour is employed, it is usually less expensive to wind with thick wire or copper strip, and designers, as a result, prefer to employ large currents in the rotor, and correspondingly low voltages. Moreover, if the voltage is kept low, the insulation question becomes of less importance, and additional saving can be made in this direction.

The issues involved thus seem to be rather conflicting, and it would be interesting to have a general expression of opinion from those who are interested in the application of polyphase power for industrial purposes.

ELECTRIC TRAMWAY AND RAILWAY EXHIBITION, 1905.

Description of Interesting Exhibits.

An attempt has been made to arrange the many items of interest in an order which has no relation to the numbers of the stalls or the names of the manufacturers, and it is hoped that this arrangement will make the whole thing more interesting than is the case sometimes; detailed descriptions of exhibits compiled in no particular order are apt to be confusing and lifeless.

Owing to the difficulty in obtaining blocks or photographs from exhibitors in time, it is almost too much to hope that the first part of the descriptive matter will be as complete or well arranged as we could wish, and we are constrained to pray for the clemency of our readers and of the exhibitors. A word of thanks is due to the latter for the courtesy invariably extended to our representative, without which, of course, we could have done nothing effectually.

Wherever it has been possible in the following columns we have tried to include only those articles which have something of novelty to commend them to the notice of our readers, for however ingenious and however useful the older or better-known articles may be, we conceive that we should earn no thanks for filling our columns with detailed descriptions of them.

1. *Automobiles.* — Six firms showed public service vehicles, chiefly omnibuses, and we do not agree with the remarks which we heard drop from several gentlemen that it was a shame to let these motor-'buses be shown in competition with electric tramcars. That is not the attitude which we should like to see taken towards vehicles which are likely to become highly useful auxiliaries and pioneer scouts to the more substantial electric tramway. There is lots of room for both, and there is much scope for improvement in both—most room naturally for the junior partner in the business of carrying the people.

The Motor-Car Emporium, Ltd., show a double-decked 36-passenger 30-h.p. petrol 'bus, with both inlet and exhaust valves operated mechanically, and having two independent sets of electric ignition. Both these provisions ought to reduce the number of involuntary stops. They exhibit also a char-à-banc carrying 20 passengers, and two lorries.

Messrs. Clarkson, Ltd., of Chelmsford, are represented by a chassis for a 32-h.p. steam engine and by a pair of steam engines, and a new type semi-flash boiler. They obtain the well-known advantages of a steam car, and burn paraffin for fuel instead of the more expensive petrol.

Messrs. Dubham, Churchill & Co., Sheffield, were unable to spare the two 'buses which they wished to exhibit, but they have an interesting char-à-banc on view.

The 12-h.p. 16-passenger single-decked 'bus on Messrs. Scott, Stirling & Co.'s stand is particularly interesting, because of the elimination of the circulating pump with its troublesome leaks, wearing spindle and glands, and chain belt or friction drive which was ready to give trouble at any moment. The thermo-siphon system, as used by the Scott, Stirling Co., which is nothing but the natural circulation system of every hot-water heating apparatus, is coming into wider use as its capabilities become known. "The makers claim for this form of omnibus greater economy in running costs and maintenance than any other system of street locomotion." Perhaps one of these days the makers may be able to substantiate that claim against electric trams—but we have our doubts.

The Wolseley Tool and Motor-Car Co. show a 20-h.p. motor-omnibus, similar to those which they have supplied to the London companies. It has the characteristic horizontal engine. Most 20-h.p. motor-car engines are divided into four cylinders, but the Wolseley Co. is content with two of 6 in. diameter × 7 in. stroke. Three independent brakes are provided, and the front wheels cannot be deflected by encountering an obstruction, owing to the steering motion being transmitted through a worm wheel and sector from the pillar.

Messrs. Straker & Squire exhibit a "Standard" 24-h.p. 34-passenger double-decked 'bus, which has run over 10,000 miles already. The car is started through a spring drive, to cushion the disagreeable shock which is too commonly felt on other automobiles. All valves are operated mechanically, and the valve-gear can be removed easily —a valuable feature in any motor-car.

The Peebles Steam Car Co., Ltd.—The rail car which forms the sole exhibit on this stand has to be included under the general heading of automobiles. Rail-cars of this pattern built by Ganz & Co. have been supplied to foreign railways, and there is an excellent opening for them in Britain, for the enterprising example set by the Great Western is being followed by all the other companies, and we believe that the single rail-car system will do more within the next ten years to brighten up the dividends of our railways than any improvement of the last 50 years. Not only will these cars reduce the cost of running on branch lines and on main lines between small stations, but they will increase the gross revenue, too. These rail-cars will form the intermediate step between heavy steam trains and electric traction.

The Hungarian Government made extensive trials with three of these Peebles cars, ordered 25 on the strength of the trials, and now have ordered 300 more.

At present the cars are made in three sizes, as follows:—

1. 35 h.p.; 36 passengers; 30 miles per hour.
2. 50 h.p.; 48 „ 35 „ „
3. 80 h.p.; 64 „ 40 „ „

The car shown is not built according to English ideas, and looks somewhat strange to English eyes in consequence, but it is very substantially constructed, and is claimed to have a greater fuel and water capacity than most cars.

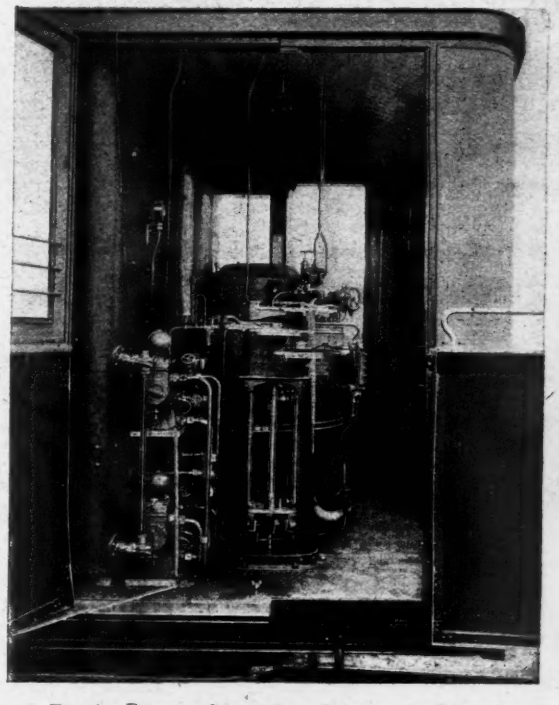


Fig. 1.—Peebles Steam Car: Interior of Driver's Compartment.

Fig. 2.—Truck of Peebles Steam Car.

The car runs on two bogies, one of which carries the engine. This engine is coupled to the boiler on the car by means of a multitude of small flexible pipes, and drives the wheels through gearing. Owing to the method of driving, the impulses upon the driving wheels are made more uniform, while oscillation is reduced to a minimum.

The accompanying illustrations, figs. 1 and 2, show the interior of the driver's compartment and the construction of the truck.

2. *Boilers and Accessories.*—There is a representative display of boilers, stokers and parts, but nothing of any great novelty.

Taking the exhibitors in the order of their stands, we come first to the Stirling Boiler Co., Ltd., who show the usual working models, and some interesting photographs of installations, including the Greenwich power station of the L.C.C.

Although the Hunt conveyor made by Messrs. Babcock & Wilcox, Ltd., is well known, it has not been on exhibition before. It is of the bucket type, and is beautifully designed. The qualities of the bucket conveyor in general and of the B. & W. conveyor in particular are so widely realised that we shall not attempt a description. Attention is drawn to the main features in the Exhibition catalogue. On the same stand are to be seen models of the B. & W. boiler, chain-grate stoker, and Guttman's patent water-

softening plant—altogether an interesting stand for the steam user. The illustration below shows the conveyor exhibited.

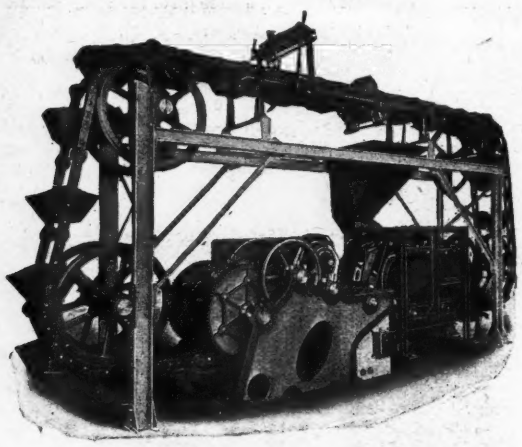


Fig. 3.—Babcock & Wilcox Conveyor, Fitted with Filler and Automatic Oiling Apparatus.

Owing to an unfortunate accident to their machinery, Messrs. Graham, Morton & Co.'s stand is bare, except that the walls are covered with photographs of conveyors of all kinds as installed for all purposes. They intended to show five different kinds of conveyors actually working, and much regret is felt that such an educational opportunity has been lost.

McPhail & Simpson's Dry Steam Patents Co., Ltd., Wakefield, have a stand containing parts of their independently-fired superheater.

Messrs. Meldrum Bros. have a large stand, the contents of which comprise the stoker and furnace specialities for which they are famous. The most interesting, perhaps, is the improvement by which the supply of air over the grate is regulated automatically, being cut off altogether when the volatile gases have been consumed.

Besides their ever-green fuel economiser, which is too well known to need description, Messrs. E. Green & Son, Ltd., show the "Wakefield" patent pump, which has several points of merit.

Messrs. Holden & Brooke are represented well. The most interesting items are Leinert's water meter, and Brooke's oil separator and discharger.

Fig. 4 shows a sectional view of the water meter. The power station engineer has sighed long enough for a meter which will even work under all conditions of temperature. That it

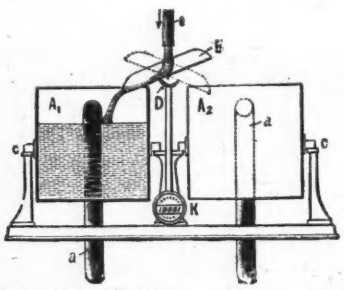


Fig. 4.—Section of Leinert Water Meter.

should work accurately has been a dream in which he has not indulged unless of an extremely sanguine temperament.

The exhibition of the Leinert meter should go far to make our engineers happy, if it performs in practice what we might prophesy for it after an examination of the apparatus.

It is constructed on the principle of an automatic weigher. The water runs continuously to the meter, but is diverted by an automatic feed alternately to one or the other of two similar tanks A_1, A_2. These tanks are balanced on knife-edges in such a way that a certain weight of water will tilt the tank, and at the same moment transfer the feed to the other tank. Each tank upon tilting, commences to empty through a siphon *a*, and returns empty to its original position in time to receive the feed as the companion tank falls and tilts the feeder B, and recorder D.

The water, therefore, is measured by weight, and the meter can thus deal with water of varying temperatures without impairing its accuracy in the slightest. It is very simply and strongly constructed.

The "high velocity" feed-water heaters, water separators, expansion steam traps, exhaust heads, injectors, and a variety of Green's patent balanced stop valves are exhibited, together with a novelty in the shape of an automatic heat regulator, by which hot water of any desired temperature can be supplied to lavatories, shops, factories, &c. The regulator is set to allow steam to be condensed until the water is heated to any desired temperature, when steam is at once shut off and re-admitted only when the temperature of the water falls from any cause. The whole action is automatic.

Messrs. Aiton & Co., London, show some remarkable specimens of wrought-steel piping, the way in which some of the pipes have been bent proving the high quality both of the material and of the workmanship.

Messrs. Bennis & Co., Ltd., claim with good reason that their exhibit "is the most complete of its kind that has ever been shown to the public." It consists of a complete installation of overhead coal storage bunkers, to which coal is supplied by the Bennis steel chain conveyor, which is made of a Siemens-Martin mild-steel drag chain running in a hard cast-iron trough. The chain is used on its return journey from the coal bunkers for removing ashes from the boiler fronts. Coal descends from the hoppers of the bunkers to the hoppers of Bennis patent automatic stokers, from which it is supplied to the fire by a sprinkling blade at rates and in amounts which can be varied, the grate being covered evenly by regulating automatically the force with which the sprinkling blade is released.

The most interesting part of the system is the Bennis and Miller-Bennett chain-grate stoker, which is on view for the first time. The Electrical Review has criticised the defective design of every chain-grate which has been used in this country, and the designers of the Bennis-Miller-Bennett grate seem to have done much to remedy previous faults, which lay chiefly in the excessive leakage of air at the front and back of the furnace.

Excellent results have been obtained with this grate at the Kensington and Notting Hill electricity works.

The Bruun-Lowener water softening system is exhibited by Messrs. Lassen & Hjort, London. The principal feature of this apparatus is the simple and automatic way in which the chemical reagent is mixed with the hard water.

The water to be treated is let into an oscillating receiver, which tips over every time it is filled. This movement opens a valve, through which an ascertained quantity of the chemical reagent passes. The quantity of chemicals can be adjusted to suit the degree of hardness of the water. After receiving the chemicals the water passes to a heater and filter, and thence to the storage tank.

Messrs. Chas. Winn & Co., Thos. Noakes & Sons and S. Dixon & Son all show a variety of steam and boiler fittings; while Messrs. A. Haacke & Co. and Circulators, Ltd., exhibit non-conducting compositions for covering boilers and steam pipes.

The Triumph Stoker Co. and Messrs. James Proctor, Ltd., each show their own kind of mechanical stoker and furnace, which are too well-known to need description.

Messrs. Circulators, Ltd. Anything which will improve the sluggish circulation of the contents of a Lancashire or Cornish boiler, and anything which will ameliorate the harsh conditions of combustion in the furnaces of those boilers, ought to be examined with much attention. The stand of Circulators, Ltd., is occupied by appliances which are directed towards the attainment of both these ends, and working models are in operation. It is claimed for the "Schofield" circulators that they are self-fitting and self-supporting, requiring no hole to be made in any part of the boiler. They can be removed for inspection, and while

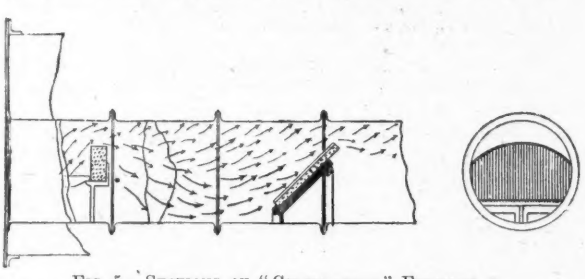


Fig. 5.—Sections of "Circulators" Furnace.

permitting an economy of 10 per cent. to 15 per cent. in fuel, they enable steam to be raised in less than half the usual time without unequal expansion of the boiler structure. Fig. 5 shows the firm's patent deflector and furnace bridge applied to a Lancashire boiler, which secure further economy by forcing the coal gases and air to mix intimately, and by adding a certain reverberatory element to the furnace which is badly wanted in all internally fired tubular boilers.

The Underfeed Stoker Co., Ltd., London, exhibit their well-known coking stoker, of which 4,000 are in use all over the world.

Air pumps, by the Edwards Air-Pump Syndicate, and feed pumps made by the Haste Pump Co., Ltd., are well representative of the best of their respective kinds.

For a Tramways Exhibition we think that the boiler and accessories section has been very well filled. Almost every conceivable necessity of economical working is stalled, and the actual operation of the machinery either on the full size or on the model scale added attractiveness to many visitors, and served to explain in the most graphic manner possible the various advantages which the energetic representatives of each firm lost no opportunity of pointing out.

Next week we shall deal with the many interesting exhibits pertaining to cars.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Refuse Destructors.

I should like to add a little discussion of an unbiased description to the somewhat useless contributions that have appeared in your issues of June 2nd and 22nd. "Cell" has evidently been having a time with his committee, and from the tone of his letter does not seem to have impressed them. Mr. Goodrich, on the other hand, has not taken into consideration all the facts of the case.

Referring to "Cell's" remark that it is cheaper to work a destructor alone than when combined with an electricity works, Mr. Goodrich says that the labour cost in a combined destructor is lower than in one worked separately; this is unlikely, but at any rate, he has altogether omitted to consider any of the other costs.

An electricity works, as he himself states, is usually built in the middle of the town where land is dearer, and where it is usually desirable to erect a somewhat more costly building, and in the combined station with which I am connected, I estimate that in this one item alone 1s. per ton would have been saved by putting up a common brick building at a very suitable site about a mile away. The extra cost of carting would have been absolutely nothing, as although some districts would be further away for carting, others would be quite close. When a destructor gains £650 per annum for sale of steam as in Partick, and pays away £700 in increased capital charges as well as larger maintenance charges owing to longer lengths of flues, &c., it is carrying the economy craze a little too far.

And this is only one side of the question, namely, that from the Sanitary Committee's point of view. But is the electricity department to get no benefit from this combination? There is not the slightest doubt as to the dirt and filth of such a place. The dust, in spite of 18-in. walls in between, gets out and in through louvre ventilators and settles on everything in the engine room in a few hours, thick enough to write your name in. This must increase the maintenance on the station, as it is a particularly gritty form of dust. Then the destructor takes the best of the load factor, leaving the coal boiler the peaks, and yet the Sanitary Committee expect to be paid the same price for steam as your coal boilers produce it at. Also steam pipes are about three times the length, with a large increase in valves and joints, and with bigger radiation losses, maintenance and capital charges; and as the destructor boilers can only work at a very low duty, they are numerous, with more radiation losses, maintenance and capital charges.

Our coal costs last year were 0·35d., and we paid the destructor department 0·375d. per unit for what was generated from refuse, and I have not the slightest doubt that with a decently designed coal burning station my coal costs would be 0·15d. Every Sunday, when the destructor is not working, our coal cost is only 0·20d., even under the present poor conditions of steam pipes, &c. I estimate that the loss to the electricity department by the combination is about £1,200 per annum.

I do not wish to give the impression that a combined destructor and electricity works is always undesirable, but that all the points should be fairly considered before rushing headlong into such a scheme.

There is no doubt that there is some economy in small stations in combining *where there is nothing else to combine with but the electricity works*, but where pumping or other work is available, let it have the pleasure of the combination.

I do not consider that either of your correspondents has written anything at all to the point on this subject, but I have stated a few facts which I am prepared to substantiate at any time, and for that reason I do not make use of a *nom de plume*.

H. B. Maxwell,
Burgh Electrical Engineer.

Partick, *July 6th*, 1905.

Costs of Power Generation.

I have read with interest your correspondent "Motive Power's" letter, also your note on the same, which is very much to the point, and it is only by comparing notes that we are likely to arrive at reliable figures.

I give my experience with a gas engine on town's gas at 2s. 4d. per 1,000 ft. I had a new 12-H.P. gas engine put down to cope with on occasional load of about 10 B.H.P. and a mean load of about 4 B.H.P. Result, an average gas bill of 14s. per week of 50 hours, which, with oil and repairs reaches 17s., or 1·02d. per B.H.P. per hour, and I have not included in this the man's time in looking after it, particularly in starting. As for steam for small power users with no complications, it is even more expensive than town's gas. I have before me particulars of a test taken at a small mill using 11 B.H.P. mean over the day, the mean I.H.P., 30. The mill-owner admitted costs of £40 per quarter of, say, 700 hours, which works out at 1·24d. per B.H.P.-hour. The complication, however, arises by the use of steam for purposes other than driving, and is a serious one. For mills of over 100 B.H.P. the cost varies very considerably. A mill of, say, 400 B.H.P., with well-arranged drive and modern engine, with good slack at, say, 6s. per ton delivered, will get its running costs down to ·4d. per B.H.P.-hour, and its capital costs will be ·2d., making a total of ·6d., and between this and 1d. will be found the cost per B.H.P.-hour of most mills of between 100 and 400 H.P. One point which we, as electrical engineers, cannot make too much of, is that our savings do not end in the engine room. In one case which has lately come under my notice, the main belting alone cost more than the electrical equipment of the mill. We are often told, when we mention capital charges, that motors are capital; quite so, but the motor replaces belting and shafting, and, what is more, the depreciation on belting is much greater than on motors.

Engineer.

Engineering Mathematics.

Mr. F. W. Carter has discovered an illegitimacy in the article on "Transformer Design" appearing in your issue of June 16th. In reality, the differentiation is only permissible where given stock transformers may have to be placed on circuits having a difference in frequency (of course, this difference must necessarily be quite limited). The writer is, however, aware that in designing a transformer for a given electric lighting or power station the possible time load curve should be taken into consideration, and the interest on the cost, and with respect to the losses in the transformer, should be gone into. This was left entirely open in the above article, and the value of m (the relation of the iron loss to the copper loss) was left to be determined by the cut-and-try method. The suggested value for m was 1·5, and occurred before the differentiation with respect to frequency, which latter was not made a vital point of the article.

A. Press.

New York, *July 3rd*, 1905.

The Value of the A.M.I.E.E.

Referring to the letter *re* the above in the Electrical Review of June 16th, I regret that no further notice has been taken of the matter by other correspondents. I think there are three chief reasons why belonging to the Institution is of little value.

1. It is so easy to join the Institution.
2. No two members have been through the same course of training.
3. Influence has a lot to do with obtaining appointments.

With reference to No. 3, the following will serve as an illustration. The well-known firm of tramway contractors, Messrs. Rail Bond & Co., Ltd., are at the present time constructing a tramway at Shingleton-on-Sea. That and the name of the firm are noms-de-what you may call 'em; I do not give the proper names, for obvious reasons. Before work was started, a Mr. X applied with letters of introduction to the firm for an appointment in connection with this contract, but was told that, owing to the large staff, there was no vacancy, nor likely to be any. Soon, however, after

work was begun, the son of the borough surveyor was taken on by the contractors, though he had neither previous experience nor three recent testimonials. Comment is needless.

Referring to No. 1, a short time ago I had occasion to go to an ironmonger's here, and was surprised to find in the shop the last number of the I.E.E. journal. On reference to the list of members, I find this gentleman is an Associate. It is to be hoped in the interests of the profession that the I.E.E. will soon draw up strict rules with regard to persons seeking election. I quite agree with "A.M.I.E.E. Provincial" that some reduction should be made in the subscription for members residing a given distance from London.

Commonsense.

P.S.—The I.Mech.E. sends out to members a list of persons seeking election; why does not the I.E.E.?

Motor Load Factor v. Station Load Factor.

There seems to be a delightful variety of ideas among our station engineers on the subject of tariffs. On the one hand, we find them giving discounts in direct proportion to the load factor of the individual consumer's motor, thus in great measure neglecting the station load factor, and on the other hand, we have the "Dundee" system of charging, which practically bases everything upon the station load factor. I submit that neither of these is right. I will, with your permission, Mr. Editor, try to formulate a simple hypothetical case to illustrate the various relations of motor load factor, diversity factor, station load factor ("Cromptonian" sense), and standing charges.

Consider (1) a station which supplies 24 motors, each fully loaded throughout the 24 hours. Let the motors be of, say, 100 H.P. each. The station load factor is, here 100 per cent.; the motor load factor, 100 per cent.; the diversity factor, unity.

Next consider (2) a smaller station supplying the same 24 motors, but in the following way. Each motor only runs for one hour, one motor being shut down before the next is started up. Here the motor load factor is $4\frac{1}{6}$ per cent., instead of 100 per cent., the diversity factor is 24·0, and the station load factor is 100 per cent. The station capacity is, however, now only 100 H.P.; so, to put things on all fours as far as the two stations are concerned, let the number of motors (*i.e.*, consumers) be increased 24 times.

We may then express results as follows:—

	Case (1).	Case (2).
Number of motors...	24	576
H.P. of each...	100	100
Units sold per consumer per annum (say)	200,000	say 8,333
Diversity factor	1	24
Motor load factor	100%	$4\frac{1}{6}\% = \frac{1}{24}$
Station load factor	100%	100%
Station H.P.	2,400	2,400
Total units sold per annum (say) ...	4,800,000	4,800,000
Total H.P. connected to mains	2,400	57,600

Now consider the annual charges, and, for the sake of fixing proportions, take figures roughly as for Brighton in 1900, and we have, say:—

	Case (1).	Case (2).
Interest, &c., charges on central station	£10,000	£10,000
Interest, &c., charges on feeders, mains, and service connections	10,000	50,000
Management charges	1,500	say 2,000
Clerical staff	1,200	say 28,800
Rates, taxes and insurance	1,200	say 2,400
Motor readings and repairs...	1,000	say 24,000
Repairs to mains and service connections	1,500	say 7,500
Net profit	5,000	say 5,000
	£31,400	£129,700
Add:—Production costs at station ...	9,000	9,000
Preparation costs at station (ex. management, &c.)	10,000	10,000
	£50,400	£148,700

Some engineers, who maintain that each consumer should pay an equal profit, would put the item for net profit in case (2) at £120,000, but to spare the feelings of those who object to such a course, we will assume that it is a constant sum!

The totals, it will be seen, are in the ratio 1 to 3, and as the total number of units sold in each case is the same, it follows that the average prices per unit must be fixed also in that ratio.

Of course, it will be objected that the case is a purely imaginary and greatly exaggerated one; but it shows that motor load factor and station load factor must each be used with judgement, the one to determine charges outside the station, and the other those inside it.

In actual practice it will be found that station load factor *diminishes* with a decreasing motor load factor, *even though the motor connections be increased in the inverse ratio*, as I have shown elsewhere. This would aggravate the cost per unit in case (2).

A. M. Taylor.

King's Heath, *July 10th*, 1905.

PARLIAMENTARY.

The Telephone Agreement.

(Mr. J. GAVEY'S evidence, continued.)

ON the question of the time required to erect a complete alternative plant throughout the country, which the Corporation witnesses had estimated at four years or less (doubtless the opinion of their consulting engineer), the Witness thought that the latter had not given the question the consideration it deserved; a comparison of the estimates which he had prepared with the results obtained in practice, showed that in the majority of cases the provision he had made at the outset had been found within a very brief period to be utterly inadequate for the requirements. Hasty and ill-considered designs for a wholesale replacement of the company's existing plant would result ultimately in a very large expenditure. If the work were done wisely and well, the time the witness had specified was none too great. Proper buildings should be provided, and makeshifts avoided. Witness thought that the need for a thoroughly effective survey of every large town had been overlooked; the expense and time devoted to this would be recouped many times in the ultimate development of the system. It was rarely that a great enterprise was completed and ready for opening on the date fixed, and assuming that the plant were to be replaced, if 20 or 30 per cent. of the plant were not ready for use in 1911, the condition of things that would arise might well be imagined. His estimate was not hastily formed; he had reported on the whole subject in 1896, when he suggested that action should be taken in 1904, and, with a full sense of his responsibility, he reaffirmed his statement as to the length of time that should be devoted to working out the scheme. There had been a good deal of misconception with regard to cheap rates. So long as the great majority of users were large users, the flat rate was fair enough, but when the telephone reached small users, it ceased to be appropriate, as the large user got far more for his money than the small. The telephone service was not one which could be carried on wholesale cheaper than retail; the cost was about in proportion to the increased user by the subscriber. A really cheap service would be promoted by the use of some measured rate system, by which the large user would not be over-taxed, while the small one got his telephone as cheaply as possible. It was misleading to represent the advocates of a low flat rate as advocates of a cheap telephone, against those who advocated the more logical and scientific measured rate. The failure of the Post Office to establish exchanges in the provinces in competition with the company prior to 1900 was due to the fact that the Post Office was not allowed to canvass for subscribers. Since 1900, many successful services had been established in the provinces. The witness negotiated the purchase of the trunk lines with the engineer of the company. The price was £459,114 3s. 7d., and he was confident that it was very moderate.

Monday, July 10th.

AT the sitting of the Committee on Monday, Mr. BABINGTON SMITH, secretary to the Post Office, continued his evidence, and said that the statement of Mr. Stephenson as to charges wanted explanation. It would appear as if the Corporation charges at Glasgow and Brighton were £3 10s., as compared with £4 10s. by the Post Office, but as a matter of fact, the £4 10s. rate of the Post Office compared with the £5 rate of Brighton and Glasgow. It was said that it would be necessary for the Post Office to maintain the rates which the National Telephone Co. charged at present. That was not the case. Under the agreement in places where there was competition between the Post Office and the company, and where intercommunication was given, it was laid down that the rates should be fixed; that the two parties should do their best to arrive at an agreement as to rates, and that if they failed to arrive at such an agreement, the matter should be referred to the Treasury for final decision. Therefore there was no reason to suppose that the rates fixed in those places would be the rates at present charged by the company, and as a matter of fact, the Post Office was under no obligation to maintain the present rates at all.

The CHAIRMAN: It was suggested that large users would object to a measured rate.

WITNESS said that it was quite natural that they should. Under the unlimited service rate the large user paid an insufficient sum, while the small user paid too much. If, therefore, the charge was

made in proportion to the extent to which the telephone was used, it was natural that the large consumer should dislike it. That, however, was not a reason why the measured system should be condemned. By giving an unlimited service there was no doubt they encouraged the user to make the best of his bargain, and they put no check on the unnecessary and unprofitable use of the telephone. He claimed that the measured rate interested the user in economy, and tended to give a cheaper service. He thought there was no fear of the country being saddled for all time with a £10 rate for telephones. Even if the present Post Office rate were substituted for the company's rate, there would be a reduction.

The CHAIRMAN: You think that the present municipal experience is too short to form a sound opinion as to the working of municipal telephones?

WITNESS said that was his opinion. In several particulars the cost of the telephone system was lower in the first than in succeeding years. In some cases the maintenance of the plant was guaranteed by the contractor in the first year, and then, again, the wages and salaries of the operating staff were at their lowest point in the first year. As the system grew, the cost per subscriber grew. The number of calls by each subscriber tended to grow, because he could communicate with more subscribers, and there were more junction calls, which tended to increase the cost of operation. He bore out the statement of other witnesses that no undertaking was given to any municipal authority that its telephone licence would be renewed.

Questioned as to the statements made by the municipal witnesses, that by the agreement the National Telephone Co. would be enabled to compete unfairly with municipal corporations, WITNESS said he believed that in several respects the company would, when the agreement came into force, be in a less favourable position for competing. In the first place, they would not have such a strong inducement to carry on active competition, because, even if they were successful in squeezing out the municipality, they would not reap the result of their success, since it would be open to the Post Office to take over the municipal system and compete with the company on more favourable terms than the Corporation could, because then the company would be bound to give intercommunication. By the agreement, the Postmaster-General would have full right to compete by taking over the municipal system. Further, the Postmaster-General would have statutory powers with regard to underground works, and the company would not have any such powers except with the consent of the local authority, which, under the circumstances, they were not likely to get. The result, therefore, of the company squeezing out the municipality would be that the company would find substituted for the municipality another competitor with more formidable powers. It had been stated that the company might raise their present rates in non-competitive areas, and so compensate themselves for losses incurred where there was municipal competition, but the agreement prevented them from raising their prices above the schedule, and the schedule prices were about those the company were now charging. The general conclusion he had drawn was that so far from placing the company in a better position for carrying on competition with the municipalities, the agreement would place the company under certain circumstances in a worse position.

The CHAIRMAN: In reply to the municipal complaint that the agreement injures, or might injure, them, would your reply be that they are not so much injured but they are disappointed of obtaining certain things they would like to obtain?—Yes: that appears to me to be the basis of the greater part of the municipal evidence.

It has been said that the present capital of the company is watered, and that that constitutes an objection to the present agreement?—My answer is that one of the advantages of the agreement is that it entirely sets on one side any question of the company's capital. Nothing is to be purchased but tangible assets—the wires, instruments, buildings and lands—at their fair market value, without any allowance for compulsory purchase or profits. Therefore, in carrying out this purchase, the Postmaster-General would have absolutely nothing whatever to do with the company's capital. How much water it contains is a matter with which we have absolutely nothing whatever to do. All the Postmaster-General is interested in is to see that he does not pay more than a fair price for what he buys.

Continuing, WITNESS said there were other objections to the setting up of an alternative system, besides the engineering difficulties. One thing was that it was doubtful if the Postmaster-General could give such a service without further powers as regarded wayleaves. Further, the Postmaster-General would have to create an engineering staff, and the result would be that in 1911 the company's staff would be thrown out of employment, with nowhere to go to. By the agreement, the staff would come over to the Postmaster-General. Further than this, unless there was to be purchase it would, of course, be to the interests of the National Telephone Co. to get the last penny it could out of the service. It was not unlikely that they would double their rates; and although they would lose many subscribers, yet others would be obliged to keep on, and the company's expenses would be reduced.

In cross-examination by Mr. BENN, WITNESS said he knew nothing of what outside people thought of the agreement. The market price of the company's stock might have appreciated, but Stock Exchange opinion was often erroneous. He denied that in any of the negotiations which had taken place the Post Office had done anything to enable the company to maintain its dividends.

Mr. KEIR HARDIE: If Parliament refuses to sanction this agreement, has the Post Office any alternative scheme to put forward for continuing the telephone system in 1911?—In that event the only course would be to have a fresh agreement, or to put up an alternative system, to which there are grave objections.

Mr. DALZELL, on behalf of the Employés' Association of the National Telephone Co., afterwards gave evidence, and asked that provision should be made in the agreement for continuity of service, compensation for loss of office, and superannuation on the same lines as Government officials.

On Tuesday Mr. R. DALZELL was recalled. He said that he wished to emphasise the fact that the Postmaster-General had been receiving each year, without incurring any risk or capital expenditure, a royalty of 10 per cent. on the company's gross revenue from its exchange business, so that the staff had been working partly for the benefit of the Postmaster-General, and through the Postmaster-General, of the ratepayers. Already the Postmaster-General had received £1,800,000 in royalties. Witness proceeded to deal with the claims of the staff, which he said could be stated as follows: (*a*) Continuity of employment, with the benefit of past services for all members of the staff in the company's service immediately before December 31st, 1911; (*b*) compensation for loss of office; (*c*) superannuation for all members occupying a post or office which, if occupied in the permanent Civil Service of the State, would entitle the occupier to a superannuation allowance, or receiving a salary of £100 per annum and upwards. Witness then proceeded to point out various clauses in the agreement which, he said, clashed with those claims.

Evidence was also given by Mr. VINCENT ALSOP, a member of the Staff Association.

North-East London Railway Bill.

Wednesday, July 5th.

MR. ARNOLD HILLS was called as a witness on behalf of the opposition of the Hammersmith and North-East London Tube promoters. He said that he had made every effort to get the scheme in which he was interested before Parliament, and had spent something like £90,000 on its promotion. Referring to the omitted line to Tottenham, witness said that he could not see how the opening of the Great Northern and City line had affected that, for it served an entirely different district. He did not object to the present Bill so long as it would not bar the construction of his own scheme, or as much of it as was coincident with it. He saw no objection to a joint construction of the portion of the railway from the Monument to the Hackney Road.

Mr. MOON, K.C., then addressed the Committee on behalf of the promoters of the Hammersmith, City and North-East London Bill, pointing out to the Committee that the scheme did not carry out the requirements of the Traffic Commission. It would, he said in conclusion, interfere with the intramural communication of the whole of London.

The case for the Great Eastern Co. was then proceeded with, and Mr. J. F. S. GOODAY, the general manager of the company, was called.

Thursday, July 6th.

Col. YORKE attended at the request of the Committee. He wished to express no distinct views on the Bill, but said that the Board of Trade held the view that the ordinary conditions of the Cheap Trains Act should apply to the scheme. In his opinion a 13 ft. 6 in. tube would have been better than the size proposed—11 ft. 8¼ in. The Board of Trade had never yet held an inquiry into an accident on a tube line.

In reply to the Chairman, Sir DOUGLAS FOX said that to increase the size of the tube from 11 ft. 8¼ in. to 13 ft. 6 in. would involve an extra cost of £185,000. To increase the size to 16 ft. would mean another £460,000.

Mr. SELLON was again called, and spoke as to the cost of working electric lines, and

Mr. R. P. BROUSSON, the engineer to the Great Northern and City line, also gave evidence in support of the promoters' scheme.

Monday, July 10*th.*

Mr. J. F. S. GOODAY, called on behalf of the Great Eastern Railway Co., said that that company had done all that it could to meet the increased traffic. He was sure that the line was not required, and could not see how it could pay. The Great Eastern Co. had, by widening and lengthening its trains, greatly added to their carrying capacity, and it would in the future provide such further increased accommodation as would be necessary.

Mr. CONACHER, formerly manager to the Cambrian Railway, was called in support of the opposition, and

Mr. W. FORBES, the general manager of the London, Brighton and South Coast Railway, also gave evidence. Witness said that railway companies could not now derive profits from their short-distance traffic, but must rely upon the long-distance runs.

Mr. FREEMAN, K.C., then addressed the Committee.

Tuesday, July 11*th.*

On Tuesday, after hearing the conclusion of Mr. Freeman's case for the Great Eastern Railway Co., the Committee considered the opposition of the London County Council.

Mr. E. J. HARPER, the statistical officer to the Council, in giving evidence, dealt with the question of workmen's fares, and Mr. MAURICE FITZMAURICE, the engineer to the Council, criticised the scheme from an engineering point of view. The latter witness said that the line should be so constructed as not in any way to interfere with future schemes of transit or drainage.

Mr. BALFOUR BROWNE, K.C., having replied on the whole of the opposition, the CHAIRMAN ordered the room to be cleared. On the re-admission of parties, the chairman gave the following decision:—"The Committee has come to the conclusion that it will pass the preamble of this Bill, but that it will put upon the promoters clauses to ensure that the promoters' pair of tubes from the Monu-

ment to the Hackney Road shall be at such a depth as will admit of another pair above them. It will also put upon the promoters the obligation to find at least half their share capital within a period of one year from the passing of the Bill, and also to commence construction within two years of that date. The Committee is of opinion that if the contractors are to take a portion of their payment in shares, only half the shares so taken shall count towards the amount of capital stipulated to be raised within the one year; but we are willing to hear counsel upon this point. The fares to Walthamstow must not exceed those of the Great Eastern Railway Co. As to the report of the Royal Commission on London Traffic, the Committee is of opinion that it will be available before the Bill leaves the House of Lords. Due consideration can be given there to any findings of the Commissioners which affect this project."

The Committee then adjourned. Clauses will be considered to-day.

Metropolitan Electric Tramways Bill.—This Bill came before the Unopposed Bill Committee of the House of Lords on Tuesday. The proposal of the Bill is to authorise the widening of a number of streets in the parish of Edmonton, and to empower the company to enter into agreements with the North Metropolitan Electric Power Co., or any other authorised body, to supply electrical energy to the company. Formal evidence having been given, the Bill was ordered to proceed.

Dublin United Tramways Bill.—This Bill, which is to authorise the transfer of the undertaking of the Dublin Western Tramways and the Dublin Southern Tramways Co. to the Dublin United Tramways Co. was passed by the Unopposed Bills Committee of the House of Lords on Tuesday last.

Nottingham Corporation Tramways.—Mr. J. W. Wilson's Committee, reporting on the Nottingham Corporation Bill, states that the Board of Trade pointed out that the proposed fares on through cars by Clause 18 would confer powers to charge in excess of those which have commonly been granted by Parliament in respect of tramways, but as similar powers were given to Leeds and Glasgow, they did not suggest any alteration. The Committee did not suggest any alteration in the clause. The Committee fixed 30 years as the period for the repayment of the £57,000 wanted for tramways.

Airdrie Electric Lighting.—The Airdrie Corporation has given notice of its intention to oppose the Airdrie Burgh Electric Lighting Order, No. 8 Electric Light Confirmation Order Bill.

The London Electric Power Bills.—The following House of Commons Committee has been appointed to consider the Administrative County of London and District Electric Power Bill:—Sir James Kitson (chairman), Sir John Stirling-Maxwell, Sir Francis Evans, and Mr. John Rutherford.

Notice of opposition to the Central Electric Supply Bill has been given by the London County Council, St. Marylebone Borough Council; the Great Northern, Piccadilly and Brompton Railway; Baker Street and Waterloo Railway; and the Charing Cross, Euston and Hampstead Railway Companies.

The County of London Electric Supply Co.'s Bill will be opposed by the L.C.C. and the Camberwell Borough Council.

LEGAL.

Midwood *v.* Corporation of Manchester.

The case of A. H. Midwood & Co., Ltd., *v.* the Lord Mayor, Aldermen and Citizens of the City of Manchester, came before the Court of Appeal, consisting of the Master of the Rolls and Lords Justices Romer and Mathew, on Tuesday, on the application of the defendants for judgement or new trial on appeal from verdict and judgement at trial before Mr. Justice Lawrance and a special jury. The action was brought to recover £677 4s. 6d. damages sustained by the plaintiffs by the destruction and damage to their stock-in-trade merchandise and other property, No. 81, Fountain Street, Manchester, by a fire on May 24th, 1903, caused by the fusion of one or more electric cables or service lines belonging to the defendants, which fusion was alleged to be owing to a dangerous fault or leakage in the circuit in which the cables in Fountain Street were. Plaintiff further alleged that the defendants' system of electric lighting constituted a nuisance. Defendants pleaded that the matters complained of were incidental to, or inevitably resulted from, the due discharge of their public duty under the Electric Lighting Acts, for the result of which they were not responsible, and that the short-circuiting in their mains was not due to their negligence or the negligence of their servants, or the persons in their employ. The jury found that the system adopted by the defendants constituted a nuisance by causing danger to persons having premises adjacent to the mains, that they were guilty of negligence in adopting their methods of localising and dealing with the fault, and that when they became aware of the fault they did not deal with it for the purpose of preventing fire in a reasonable and proper manner. On these findings his Lordship accordingly entered judgement for the plaintiffs for the amount claimed, with costs. Hence the present appeal.

Mr. Fletcher Moulton, K.C., and Mr. J. W. Gordon appeared for the appellants; and Sir Edward Clarke, K.C., Mr. Bousfield, K.C., and Mr. Wood Hill for the respondents.

Mr. Moulton, K.C., in opening the case, said that the Corporation of Manchester had the electric supply, the gas supply, and the water supply in its own hands, and it was the undertaker of a provisional order granted to it for a supply of electricity. The first point which was raised in the case was whether the accident was due to any negligence on the part of the Corporation, and a still more serious point involved in the case was as to whether or not the defendants were guilty of a nuisance in having their mains in the streets of the City of Manchester. Dealing with the questions left to the jury, the learned counsel said that when he came to the question of negligence, he should submit that there was not the slightest evidence of negligence at all on the part of the Corporation. If the system was a nuisance to the city, that would carry the verdict no doubt quite apart from any question of negligence.

Lord Justice Mathew said that the question appeared to turn on certain sections of the Act of Parliament.

Mr. Moulton agreed. He thought the plaintiffs admitted that the defendants' system of laying mains was the best known, and that they had supplied electricity in accordance with the conditions laid down by the Board of Trade. He confessed he did not understand the finding of the jury, or the summing up of the learned judge, on the subject of nuisance. It appeared to him that the finding of the jury amounted to saying that the carrying out of the statutory duties was *per se* a nuisance, and he could not believe, if he established that that was the effect of the finding, that it was consistent with legislation.

The learned counsel continuing, said the legislation with regard to electric lighting undertakings was based on two fundamental Acts of Parliament of 1882 and 1888, which were public general Acts. Under those Acts each particular undertaking had to be authorised by a provisional order, which order was statutory as much as the Acts themselves. The position of an undertaker under such a provisional order was not that of a person who might, or might not, supply electricity as he liked. He was bound to supply to the public according to the provisions of the order, the obligation of the supply being an absolute one on the undertaking. There were penalties for the failure of the supply; Sec. 67, of the Act of 1888, stated that the undertakers should be answerable for all accidents, damages and injuries happening from an act of, or default of, the undertakers. That section, however, he submitted, referred to unlawful acts and defaults, and not to the proper carrying out of the undertaking. The regulations of the Board of Trade, which were made binding on the defendants, required that the defendants should keep a constant electrical pressure in all their mains. They had to keep it constant and going day and night. The system of supply adopted was the system of supply of every electrical undertaking, and was a system which had essentially at least two mains. This system had five. The whole idea of the electrical supply was to use two copper mains—one positive and the other negative—and there was an electrical pressure in the positive one, say 100 volts higher than in the negative. These were laid all over the town. Branches from them went into every house, and every lamp stood astraddle those mains. The consequence was that the little filament of each lamp was the means by which electricity ran from one main to the other. They must use both negative and positive mains. There must be metallic connection going into every house. For the purpose of saving copper in the mains, the system had been elaborated, and instead of having two mains they had three. Dr. Hopkinson had a more elaborate one, he had five wires. For the purpose of this case their Lordships might take it that these were all wires surrounded by india-rubber or some insulator, and they were buried in a trough filled with bitumen, so that the wires could not touch one another. He could not find that that was objected to. It was practically admitted that that was the way of laying the mains. It was absolutely essential that the electrical pressure should be constant. Defendants were only allowed to vary 2 per cent. from the standard over the whole area. In order that that might be so, it was essential to have the network of mains fed with electricity at a large number of points. The only objection raised to the system was this: It was suggested that the method of having the network all over the town made it difficult, if there should be a breakdown, to see where it was. In the present case there was a leak across the mains. On Sunday morning of May 24th, about half-past one, the instrument at the central station in Dickinson Street showed indications that a leak had broken out. Thereupon the mains engineer was telephoned for, and told that there was a leak somewhere. He telephoned back telling them to divide the system. The system then consisted of three districts—the northern, central and south-eastern. Howard, the mains engineer, told them to divide the system by throwing off the south-eastern. That left the northern and the central united. The south-eastern had generators of its own. It received a supply from an outside station a long way off, which worked generators in the south-eastern. Howard then came down to Dickinson Street, and proceeded to separate the central and northern, but before he did that, he had to divide the supply so as to feed both. He was just doing this when someone said that smoke was seen coming from the pavement in Fountain Street. Howard jumped into a cab and went to Fountain Street in order to cut off the main, but just before he arrived the explosion had taken place which caused the damage. He was going to show their Lordships that the defendants' was the best system for finding where there was a leak and getting at it; and secondly, that on the night in question defendants did all that is was possible to do after the breakdown occurred.

The hearing was adjourned.

On Wednesday, Mr. Fletcher Moulton, continuing his argu-

ments, said the system of interlinked circuits with feeders was unquestionably the best according to electrical knowledge and reliable expert evidence. He felt he was exaggerating the evidence against him when he took any notice of this point. The only person called to suggest there was another system gave a perfectly fanciful description of the Liverpool system. The system described by that witness was the worst system of maintaining pressure, and it had the disadvantage, if a fault occurred, of putting the whole region in darkness. It was too preposterous that the evidence of a man who had no extensive experience of works of this kind should be allowed to weigh in the decision of a point so grave as this. The Board of Trade had sanctioned this system, and the engineers of two of the largest systems in London, as well as experts like Mr. Swinburne, had said that the system was the best for all purposes. There was an obligation under the Board of Trade regulations and under the statute that the pressure must be kept constant and not allowed to fall. A nuisance was a thing that must be abated. It must be removed. The statute did not allow the Corporation to remove this system.

Lord Justice Romer: What is contended is that where you have a leakage like this resulting in explosion, that is a nuisance. If you let these things go on and pay no attention to such explosions, can they not stop you?

Mr. Moulton contended that if it turned out from the evidence that they were carrying on their system in the best way possible there could be no nuisance. If negligence was proved, then, of course, the Corporation could be held liable. There could be no nuisance if they did in the ordinary way what they were obliged to do by statute. It had been suggested that what they were doing was analogous to storing gunpowder in a house without adequate protection. Unquestionably, the supply of electricity had been of the very greatest benefit, and the risks of fire had been very largely diminished. Everyone appreciated the conveniences of electricity, but now it was said by the verdict in this case that the Corporation, in giving this advantage to the public by the very best system they knew of, were creating a nuisance, because they had laid down electric power in all the streets.

Lord Justice Mathew: Where is to be the limit? On that principle every electrical supply company would be liable to the same attack.

Mr. Moulton: Yes, absolutely.

Lord Justice Romer: Is it said that your system necessitates such accidents as these?

Mr. Moulton: No. We say it is absolutely impossible to prevent occasional accidents.

The learned counsel proceeding, argued that there must be a risk with every system, and that there was nothing in this case to show that there was a wanton risk in connection with the Manchester system, or that that system was a nuisance. It was perfectly impossible to work a large system and keep up the pressure all over, unless they had a linked-up circuit.

(To be continued.)

Bruce Peebles & Co., Ltd., *v.* Mica Insulator Co., Ltd.

This reclaiming note brought under review of the Court of Session the interlocutor of Lord Stormonth-Darling, allowing proof in the action by the Mica Insulator Co., Ltd., against Bruce Peebles & Co., Ltd. The pursuers sued for £500 damages in respect of alleged breach of contract, and also for interdict in respect of the alleged infringement of two patents for improvements in electrical insulating sheets. The defenders denied the breach of contract, and disputed the validity of the patents on the ground of anticipation and prior use. It was admitted that there must be a proof on the question of breach of contract, but on the other branch of the case the defenders maintained that the pursuers' allegations were not relevant, in that they were wanting in sufficient specification to be remitted to probation.

The Division gave effect to the defenders' contention, and the interlocutor of the Lord Ordinary was accordingly recalled and the case continued for 10 days in order that the pursuers might consider whether they would amend their record or not.—*Scotsman.*

British Electric Traction Co. *v.* Chadwell—The Bideford and Westward Ho Tramway.

In the King's Bench Division of the High Court of Justice on Monday and Tuesday, Mr. Justice Walton had again before him the action of the British Electric Traction Co. *v.* Chadwell, which was part heard before his Lordship on May 30th last, and reported in the Electrical Review. The case arose out of a contract by the British Electric Traction Co., Ltd., and the Bideford and Westward Ho and Appledore Railway Co. with Mr. Charles Chadwell, contractor, of Blackburn, and the claim was for money expended by plaintiffs in completing certain works undertaken under an agreement dated February 9th, 1900. The plaintiffs said it was agreed between all the parties that in the event of the defendant wilfully making default in proceeding in due course with the execution of the works, which consisted of certain electric tramway constructions, the plaintiffs might complete them and recover any extra expense which they might incur. The plaintiffs claimed over £12,000, but after certain allowances had been made to the defendant for materials left on the ground, and other items, it was reduced to £8,690. When the case was before his Lordship in May last, the defendant did not appear, and he was now allowed to come into Court and defend.

Mr. Llewellyn Davies and Mr. Jones now appeared for plaintiffs, and Mr. Ashton for the defendant.

Plaintiffs' case, put shortly, was that the defendant commenced the work in question, but that after a short period, viz., on July 16th, 1900, he ceased, with the result that plaintiffs had to continue and complete it; and they sued for the cost of doing this, less what had been allowed to the defendant.

Mr. Ashton argued, and called witnesses in support of his contention, that the true construction of the agreement gave plaintiffs no power to remove the defendant from the execution of the work, which they purported to do, by giving him seven days' notice. The defendant, he said, also contended that as plaintiffs had failed to obtain the approval of the Board of Trade and the Corporation of Bideford to the construction of certain portions of the Bideford Tramways, he was totally unable to continue the work, and he counterclaimed damages in consequence.

There was a good deal of evidence called as to disputed accounts between the parties, and many details were gone into.

Mr. Justice Walton in the result entered judgement for plaintiffs for £7,500, with costs.

Rogers *v.* the Mayor, &c., of Cardiff.

This case came before the Court of Appeal, consisting of Lords Justices Romer and Mathew, on Monday, on the application of the defendants for a stay of execution with regard to costs, pending an appeal from a judgement of the County Court Judge in favour of the plaintiff in arbitration proceedings under the Workmen's Compensation Act, 1897.

Mr. Bailhache, for the defendants, said that the County Court Judge made an award in the plaintiff's favour for 12s. 6d. a week during the continuance of the disablement, and he directed that the defendants should pay the costs of the arbitration proceedings. Defendants did not ask for a stay with reference to the weekly compensation which they were paying, and were content to pay, to the plaintiff until the appeal could be heard. The defendants, however, asked for a stay with regard to the costs as the plaintiff's solicitor had refused to give an undertaking to return them if the defendants appeal proved successful. The learned Counsel said that the Corporation ran their own electric tramway, and the plaintiff was a man who drove a tower-wagon about to attend to the overhead wires. The question to be decided was whether at the time of the accident he was engaged "on, in, or about an engineering work" within the meaning of the Act.

Their Lordships, granted a stay of execution as to the costs as asked.

Water-Tube Boiler Cases.

In the Chancery Division of the High Court of Justice on Monday (July 10th), in the cases of Spearing *v.* Babcock & Wilcox, Ltd., and Francis *v.* the same, Mr. Rufus Isaacs, K.C., on behalf of the plaintiffs, moved that these cases might be advanced, or that the trial might be postponed so that Spearing's action might be tried immediately after the other. He said the object of the motion was to save expense, as one of the main issues involved the same evidence in each case. An action had been brought by Babcock and Wilcox against Sugden, Ltd., and Spearing, which had for its object to restrict the defendants from manufacturing water-tube boilers. The result of that action was a compromise. In these actions that compromise was impeached on the ground that certain material facts were not known to the plaintiffs.

Mr. Buckmaster, K.C., for the defendants, opposed the application on the ground that there was no foundation for it.

Mr. Justice Buckley dismissed the application, the costs to be the defendants' in any event.

North-West London Electric Supply Co., Ltd.

In the case of Tucker *v.* this company, which came before Mr. Justice Swinfen Eady on Tuesday, the plaintiff, who is a debenture-holder, sought an order to enforce his security.

Mr. Frank Russell said the plaintiff was the holder of 32 debentures of £50 each, out of an issue of £30,000. Interest was due and owing for the half-year ending December 30th, 1903, and notice had been served calling in the principal moneys. There had been negotiations for the sale of the property, and a deposit had been paid, and it was hoped that by the time the purchase money was available for distribution among the debenture-holders, the inquiries directed under his Lordship's order would be completed.

His Lordship directed certain accounts and inquiries to be taken, and made the usual judgement in a debenture-holder's action. The further consideration was adjourned to Chambers.

British Motor-Cars.—It is satisfactory to note that in the recent series of reliability, non-stop, speed and hill-climbing trials, British-made motor-cars have carried off all the premier honours. In the Scottish reliability trials a British car, in addition to gaining the full complement of marks—viz., 1,000—and a non-stop certificate, also beat every foreign car by making the fastest time on the combined hill climbs. This is a point well worthy of the attention of buyers of touring cars, as showing all-round excellence.

BUSINESS NOTES.

Trolley Standard Earthing. — The dangers to passengers which may arise through leakage from the trolley head or cable to the standard on a double-deck car are well known, and one of the Board of Trade regulations issued in January last provides for the earthing of the standard by a low resistance fuse or automatic switch, together with a warning signal bell which sounds when the fuse or switch opens. This kind of device, however, has the disadvantage that after the danger signal is given, some time must necessarily elapse before the trolley pole can be removed from the wire, and during this interval accidents may happen. Earthing the standard by a direct connection is certainly an absolute protection, but has the drawback of putting a dead earth on the trolley wire until the pole is removed, thus stopping the traffic on the sections connected with the same feeder, and when the pole has been pulled down, the car is helpless. To obviate these difficulties, Mr. P. J. Pringle, engineer and manager of the Burton-upon-Trent Corporation tramways, has designed the automatic indicating and earthing device illustrated herewith.

The earth lead from the trolley standard is taken to the terminal A, which is in connection with the switch contact B. The switch blade C pivoted on the screw D is directly connected to earth through a solenoid attached to the back of the base board shown. E is the indicating lever, pivoted at F, and fitted at its lower end with a segment piece, and at its upper end with an indicating red flag and a catch piece, which engages in the armature G. The solenoid is wound round an iron core, and G is attached to its lower end, the upper end being normally a short distance away from the pole-piece. When the lever E is in the position shown in fig. 1, the segment piece J prevents any movement of the earth switch handle H, making it impossible for the earth switch to be opened. Should a leak develop in the trolley standard and a small current pass to earth, the armature G is attracted, and releases the lever E, so that it falls into a half-cock position. It is held there so long as the current continues to pass through the solenoid. When in this position the segment J still continues to lock the switch handle H, otherwise it would be possible to open the earth switch in error before the trolley was removed from the wire. As soon as the indicator lever has got to the half-cock position, the red disk becomes visible, and the two contact springs to the left of the indicator lever are brought into contact, and ring either the car electric bell or a supplementary one. On the conductor removing the trolley from the trolley wire, the armature G regains its normal position, and the indicator lever falls to full-cock, the bell continuing to be rung.

The interlock is now taken off the handle H, and the earth switch can be opened. Once the handle H has been pushed up (fig. 2), the earth switch is locked in the open position with the indicator at danger, and neither can be interfered with until the car has returned to depôt for repairs. When the repair is completed, the indicator lever can be pushed into its normal position, as shown in fig. 1, when it is interlocked again with the armature piece. The action of moving this lever releases the earth switch-blade, and a spring automatically pulls it into its normal position, causing the earth connection to be renewed.

In the event of the fault being a dead short, the circuit-breaker or breakers supplying the section on which the car is running come out, the solenoid is demagnetised, and the indicator lever falls at once to its full-cock position, the cycle of operations being the same as before.

The solenoid, in an earthing device suited to the Burton-on-Trent tramways, will operate with a leakage current of 3 to 4 amperes, and carry a short-circuit discharge current of 1,500 amperes.

The usual custom, when a trolley standard has become alive, is to clear the top deck and proceed with the journey as far as is necessary, and then return to depôt. It is always possible under these conditions for a passenger to ascend the top deck while the conductor's attention is withdrawn. To avoid this possibility Mr. Pringle has devised the use of chains or bars at the bottom of both staircases to prevent access to the top deck, in conjunction with a contact normally closed and in parallel with the bell operating contacts connected with the earthing switch blade. With this arrangement the bell would continue to ring until both staircases had been barred, the action of placing the chain or bar across causing the bell contacts to become opened. Should the earth switch be opened before the staircases were barred, the alarm would still continue to ring, drawing the attention of the car attendant to this omission.

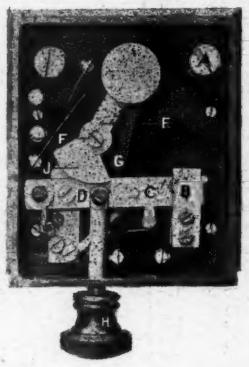


Fig. 1.

Fig. 2.

Fig. 3.

Trolley Standard Earthing.

Dissolution, Liquidations, &c. — The partnership hitherto existing between Mr. R. G. Tyler and Mr. W. E. Duncan has been dissolved, owing to the latter having accepted an appointment in Canada. Mr. Tyler has taken into partnership Mr. E. H. Freeman, A.I.E.E., late of Johannesburg, and the firm will continue to carry on the business at 20, New Bridge Street, E.C., under the title of Tyler & Freeman.

The Garcin-Renault Electric Cars and Accumulators, Ltd. —On Tuesday the statutory meetings of the creditors and shareholders of this company (in liquidation) were held before Mr. Winearls, Assistant Official Receiver. An approximate statement of affairs was submitted showing total liabilities £3,284 15s. 6d. (unsecured £2,774 12s.) and assets £71 2s. 10d., after deducting £10 3s. 6d. for the preferential claims. The account with the contributories disclosed a deficiency of £2,773 9s. 2d. The chairman reported that the company was formed in October, 1904, with a capital of £20,000, divided into 2,000 shares of £10 each, for the purpose of dealing in motors, and to adopt an agreement dated October 13th, 1904, between Mr. Paul Verhaeghe and Mr. H. T. Page as trustee for the company. The only officer from whom the Official Receiver had been able to obtain information was Mr. Paul Mitton, the secretary. The only shares issued were the seven subscribed for by the signatories, six of whom had paid up £2 10s. 0d. per share. The agreement between Messrs. Verhaeghe and Page was adopted by the company, and provided for the purchase by the company from Mr. Verhaeghe of (1) the benefit of an agreement which he had entered into with Messrs. Garcin and Renault, of Paris, for the sole agency in the United Kingdom and the Colonies for Garcin-Renault electric cars and accumulators; (2) four electric motor-cars, a carriage lift, and two Westinghouse generators; (3) goodwill of the business of motor-car and accessories dealer carried on by Mr. Verhaeghe at Addison Bridge, Kensington; and (4) the benefit of an agreement for the lease of the premises at 5, 6 and 7, Denman Street, W.C., for twenty-one years, at a rent of £1,200 per annum, increasing to £1,700 per annum. The consideration was £3,774, payable as to £3,174 in cash and £600 in shares, and Mr. Verhaeghe was to be managing director for five years at a salary of £480 per annum with a percentage of the profits. In addition, 10,000 fr. in cash were to be paid and 200 fully-paid shares were to be issued to Messrs. Garcin and Renault, of Paris, and 30 fully-paid shares to the landlord of the Denman Street premises. The company entered into possession of the premises in Denman Street, but was not executed, and no rent was paid. Mr. Verhaeghe resigned office on December 15th, 1904, and signed a document acknowledging that he had no claim against the company. On March 28th, 1905, execution was levied on the company's premises for rates, and one of the electric landaulettes and all the movable goods on the premises were seized and sold for £205. At the beginning of April the landlord distrained for £1,210, and seized another electric landaulette which had not yet been sold. At the date of the winding-up order the landlord claimed to be in possession of the premises, and that the carriage lift and generators were fixtures, and as such belonged to him. The remaining electric landaulette was stated to be held by the company's foreman, M. Paillot, who retained it as security for his claim against the company. In the course of his efforts to trace the car, whose registered number was A 7,660, the Official Receiver was informed that M. Paillot had purchased the car for £200, which had been paid to Dr. Rene Lemaitre, a director, who claimed to be its owner. The Official Receiver had written to Dr. Lemaitre asking for information on the matter, but as yet he had received no reply. In the absence of a quorum, both meetings were formally adjourned for a week, when, unless resolutions are passed for the appointment of an outside liquidator, the matter will remain in the hands of the Official Receiver.

Yorkshire Electric Tramways Construction Syndicate, Ltd.—Creditors should send particulars of claims before August 19th to the liquidator, Mr. W. H. Andrews, of 14, Victoria Street, S.W.

Edmondson Electricity Meter Syndicate, Ltd.—A general meeting of the company will be held at 1, Cheapside, Bradford, on August 14th, at 3 p.m., to hear the account of the winding up of the company from the liquidator.

Catalogues, Lists, &c.—British Johns-Manville Co., Ltd., 81, Fenchurch Street, E.C. A very complete series of catalogues, three of which relate exclusively to the Noark fuses, giving exhaustive particulars and price of fuses for 250, 600 and 1,500—10,000 volts respectively; these are printed on paper coloured to correspond with the respective colours of the labels on the fuses in each section. A fourth (the principal) catalogue relates to Electrical Materials, and is a comprehensive list, with

descriptions and prices, of trolley wire insulators, porcelain and glass line insulators, car heaters, third rail insulators and other traction and general accessories, well printed and strongly bound.

Baxendale & Co., Miller Street, Manchester. A collection of lists and pamphlets relating to the Economical Turn-Down lamp, flexible cords, 500-volt ironclad switches and fuses, a new "Prismatic" electric light shade, cheap electroliers, "Beamolite" reflectors and Parlyphones, electric fans and machine tools.

Balcke & Co., 27, Clement's Lane, E.C. Pamphlet relating to natural and fan draught cooling towers of wood and iron.

Mavor & Coulson, Ltd., 47, King Street, Glasgow. Card giving particulars of the performance of a Pick-Quick coal-cutter, with calendar for July.

Metallic Seamless Tube Co., Ltd., Wiggin Street, Birmingham. New price list of "Metallic" steel conduits and accessories for electrical wiring, including fittings of various kinds, switches, distribution boards, tools, "Grip" fittings, &c., and a leaflet relating to "Metallic" fuse boxes in cast-iron cases, for pressures up to 500 volts.

Holden & Brooke, Ltd., Sirius Works, Manchester. Abridged catalogue of appliances for steam-power plants, such as feed-water heaters, temperature controllers for hot water systems, separators, traps, injectors, stop valves, gauges, &c.; also separate leaflets relating to some of the above.

Trading and Manufacturing Co., Ltd., Temple Bar House, E.C. Leaflets relating to the Patent Perpetual Pocket-book, vertical filing system, "Dade" perpetual ledgers, &c.

Electric and Ordnance Accessories Co., Ltd. Leaflets relating to electric fans, A.C. and D.C., and the Stellite medical coil.

Siemens Bros. & Co., Ltd. Pamphlet Y.M. 3A, describing the electric winding engines of the Siemens-Ilgner system, as installed at the Zollern II. pit, the Government salt mines, &c. The pamphlet is handsomely produced, and contains half-tone illustrations and drawings. An interesting load diagram, taken from a Siemens-Ilgner winding engine, is given, showing the wide fluctuations of the load.

Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street, E.C. Leaflets Nos. 10 and 20, relating to the "Igranic" motor-starting rheostats, overload and underload types, for which a reduction in price is announced.

Archibald J. Wright, Ltd., 318, Upper Street, N. Removal sale list of new and second-hand electrical and other goods, including bells, indicators, batteries, dynamos, &c.

Messrs. Elliott Bros. Catalogue of direct current electrical measuring instruments for switchboard and portable use. The instruments are entirely of British manufacture, and interchangeability of parts has been made a special feature of their construction, so that new shunts, resistances, &c., can be supplied without returning the instruments themselves. The zero can in all cases be adjusted from outside without removal from the switchboard, and the finish can be chosen to match other fittings.

The Telaupad Syndicate, Ltd., 10, Coleman Street, E.C. List of London telephone subscribers using the "Telaupad."

Messrs. Krupka & Jacoby, 61-62, Watling Street, E.C. Leaflet giving particulars of the Siemens tantalum lamp, from 11 C.P. at 50 volts to 25 C.P. at 120 volts.

Messrs. De Dion-Bouton, Ltd., 10, Great Marlborough Street, W. Description and price list of dynamo-"motor" combinations for electric lighting, &c., stationary and portable, and belt pulley-"motor" combinations for driving agricultural and other machines, "motor" pumps, &c.

Messrs. Griffiths Bros. & Co., Macks Road, S.E. Circular giving particulars of "anti-sulphuric" enamel for protecting wood, metal, &c., against acid fumes, especially in battery rooms.

Messrs. Emil Busch Optical Co., 35, Charles Street, E.C. Lists of Busch photographic lenses, field glasses, camera fittings, cameras, &c.

The British Aluminium Co., Ltd. Particulars relating to the use of aluminium for electrical conductors, giving dimensions, weights and carrying capacities of cables from ·02 to 1·67 sq. in., equal to copper cables from ·012 to 1·00 sq. in. Interesting lists of actual power lines of aluminium, carrying up to 15,000 H.P., over distances up to 154 miles, and at pressures up to 60,000 volts. Aluminium sheets and tubes are also listed.

The Metallic Paint Co., Ltd., Cardiff. Leaflets relating to metallic paints, black enamel, &c.

Messrs. E. Goossens, Pope & Co., 5, Arthur Street, W. Leaflet describing the Johnson patent lamp cap, specially designed for temporary electric lighting purposes.

The Sunderland Forge and Engineering Co., Ltd. Price list of "Pallion" induction motors, a new series, for which special advantages are claimed—from 3 to 50 H.P.

Bankruptcy Proceedings.—A. G. Inrig.—At Guildford Bankruptcy Court on July 4th, Alec Gavan Inrig, electrical engineer, of Bruce Grove, Tottenham, and late of Calydon, Goldsworth Road, Woking, was examined. Debtor said that about £260 out of his total liabilities of £290 represented law costs. He had been in business at Woking as a consulting engineer, having no capital when he commenced. He had been bankrupt previously, and his discharge was suspended for two years. Then his liabilities were over £4,000. He intimated that under the present failure there were debts due to the estate of £6,242. Mr. J. W. Brittin, assistant official receiver, said those debts were repudiated. The examination was adjourned until August 22nd.

Gerald Algar.—The first meeting of creditors was held on Wednesday at the London Bankruptcy Court, before Mr. W. G. Williams, Assistant-Receiver, under the failure of Gerald Algar, known as Gerald Leslie, Denning Road, Hampstead, electrical engineer and amusement agent. The debtor states that during the last two years he has engaged halls in provincial towns and opened exhibitions and carnivals. He owes £360 to two creditors who hired from him part of a hall at Portsmouth and erected a roundabout. He sued them for the rent, and they counterclaimed for breach of agreement on his part. They obtained a verdict for £95 and costs, and obtained a receiving order against him. The meeting was adjourned for a fortnight with a view to a settlement being made between the parties.

C. A. Smith, trading as C. J. Smith, electrician, at 23, King Street, Regent Street. Last day for receiving proofs, July 26th. Trustee, R. J. Ward, 2, Clement's Inn, W.C.

Imports of Foreign Electrical Machinery.—So far this year there has been a further falling off in the importation of foreign electrical machinery into this country. The imports in June last amounted to only £43,577 or £11,056 less than in the same month a year ago. The aggregate imports during the six months ending with June are returned at £250,616, which compares with £269,444 in the corresponding period of last year and £313,002 in the first half of 1903.

Bombay Electric Supply and Tramways.—In connection with the registration of a company to take over the concession for electric lighting and traction in Bombay, Mr. W. Gentry Bingham has written to the financial papers stating that he is taking proceedings to restrain the Corporation of Bombay from granting the concession to any company without his consent.

Steam in Sewers.—The Westminster Electricity Supply Co., the Chelsea Electricity Supply Co. and the Queen Anne's Residential Mansions and Hotel Co., Ltd., were recently summoned for permitting waste steam or water of a higher temperature than 110° F. to flow into the sewers. Mr. H. C. Dumas, counsel for the London County Council, said there was extreme danger to the health and lives of the men employed in the sewers by incoming steam. For water to enter the sewers at 110° was unpleasant to the men, and at 160° there was very great danger. In these cases the temperature of the water when tested ranged from 146° to 162°. For the defence it was urged that the necessary apparatus was being provided to prevent a recurrence. The Westminster and Chelsea Companies were each fined £20 and £16 17s. costs, and the summonses against the Queen Anne's Mansions Co. were adjourned.

An Electric Lamp Account.—Jack De Frece, licensee of the Metropole Theatre of Varieties, Camberwell, was sued at Lambeth County Court on Tuesday, before Judge Emden, by Wm. Goodson, trading as Goodson & Co., 63, Finsbury Pavement, E.C., electrical engineers, to recover £7 7s., being the price of seven dozen Wallace lamps supplied in January last at 1s. 9d. each. Mr. De Frece alleged that he had been paying 1s. per lamp for South London lamps, and that he only agreed with plaintiff's traveller to pay 8s. per dozen for the Wallace lamps. Plaintiff swore that he himself paid 1s. 9d. each for the Wallace lamps, less 33⅓ per cent., or 1s. 2d. net. Mr. Willoughby, defendant's manager, deposed that the average life of the lamps which used to be purchased at 1s. each was 1,000 hours. Those lamps were known as South London lamps. Some of the Wallace lamps only lasted 60 hours; only two now remained after 800 hours. They were now getting the South London lamps at 7d. each. He happened to be in a public house near the theatre some time ago, and overheard a conversation between Noakes, the theatre electrician, and Mr. Goodson. The former asked, "When may I expect my little bit out of those Wallace lamps?" and Mr. Goodson replied, "I will send it on on Tuesday."

Mr. Goodson, recalled, stated that, although he recollected being in a public house with the theatre electrician, he could not call to mind the conversation sworn to. It was, however, the usual custom in the trade to pay electricians 1d. per lamp on orders received. Judge Emden then entered judgement for defendant, on the ground that the £3 3s. paid into Court was sufficient.

Constant Current Street Lighting.—During the last week Messrs. Gilbert Arc Lamp Co., Ltd., Chingford, have had on view at their works one of their special moving-coil constant current transformers, and series of arc lamps and apparatus, which they invited various people who might be interested to inspect, previously to the dispatch of the apparatus to Melbourne for street lighting.

Telephone Installations.—We understand that the Telephone and Electrical Installation Co., of 11, Queen Victoria Street, E.C., with which Mr. H. Bell, A.M.I.E.E., and Mr. Stanley C. Russ, late of the National Telephone Co., are now identified, has within the past month or two carried out a number of telephonic installations, including one for Madame Melba, the renowned prima donna.

Carnival Illumination.—At a huge carnival held at the Bristol and Clifton Zoological Gardens in aid of the Bristol Royal Infirmary funds, the illuminations were carried out on an extensive plan, there being no fewer than 12,000 lights outlining the various buildings, tents, and the bridge across the lake, all wired on Verity's patent fairyland strip. Out of the 10 days allowed to carry out the wiring, four were wet, the men being unable to work. During the carnival week three days' rain were experienced without the slightest effect on the fairyland strip. Subsequently the whole of the strips, which were in lengths of 72 ft., were taken down in a day and a half. The supply was taken from the city alternating current system at 200 volts, Mr. W. H. Munton, of the Bristol Tramways Co., being responsible for carrying out the whole of the work. Not one of the many fuses used blew during the whole week.

Book Notices.—*Wechselstromtechnik.* By M. T. Zsakula. In four volumes, price 4 M. each. Vienna: A. Hartleben. These four volumes form yet another general treatise on alternate-current work, and, except as filling a gap in Hartleben's "Elektrotechnische Bibliothek," to which series they belong, it is difficult to see what useful purpose they serve. The subject is treated much as in previous text-books, including the repetition of a good deal of historical information, but the mathematics is kept within reasonable bounds, and the graphical treatment is simple. Vol. I. deals with general principles, and with single-phase work; Vol. II. with polyphase work and transmission lines; Vol. III. with alternators (principally single-phase ones); and Vol. IV. with transformers and alternating motors. The portions dealing with measuring instruments, alternator and motor testing, and with the design of the various classes of alternating current machines are incomplete, whilst some other subjects, such as the effect of armature coil and pole span on the induced voltage, the working of synchronous motors, and the action of direct-current generators when used as polyphase generators, are very fully gone into. Each volume is complete in itself, and is furnished with its own index, and with a useful collection of the principal formulæ employed.

"The Theory of Experimental Electricity." By Wm. C. D. Whetham. Cambridge: The University Press. 8s. net.

"Hydraulic Power Engineering." By G. Croydon Mark. London: Crosby Lockwood & Son. 10s. 6d. net.

"Electrical Instruments and Testing." By N. H. Schneider. London: E. and F. N. Spon. 4s. 6d. net.

"Journal of the Institution of Electrical Engineers." No. 173, Vol. 35, June, 1905. London: E. and F. N. Spon. 5s.

"Principles of Electrical Power (Continuous Current) for Mechanical Engineers." Finsbury Technical Manuals. By A. H. Bate. London: E. and F. N. Spon. 4s. 6d. net.

"Journal of the Western Society of Engineers." Vol. X., No. 3, June, 1905. Chicago: The Society. 50 cents.

"The School of Mines Quarterly." Vol. XXVI., No. 3, April, 1905. New York: Columbia University. 50 cents.

"Year Book of the Armour Institute of Technology, 1905-6." Chicago: The Institute Press.

"Modern Lightning Conductors: An Illustrated Supplement to the Report of the Lightning Research Committee of 1905." By Killingworth Hedges. London: Crosby Lockwood & Son. 6s. 6d. net.

"The Improvement of London Traffic." Paper read by Chas. S. Meik and W. Beer before the Society of Engineers on June 5th, 1905. London: P. S. King & Son. 2s. net.

The Telegraph Cable Export Trade.—June proved to be rather a busy month in the export trade of this country in telegraph cables and apparatus connected therewith, the shipments attaining a value of £157,326, or about three times those in the same month a year ago. For the six months ending with June, the returns first issued show that the shipments reached a total of £624,119, as against only £513,359 in the corresponding period of last year. The trade is, however, much quieter than in 1903, in the first half of which the exports amounted to £1,438,854.

The Transvaal.—The imports of electrical cables, wire and fittings, into the Transvaal during the three months ending with March last, attained a value of £46,000, as compared with only £19,000 in the corresponding quarter of 1904.

Automobile Notes.—London.—The Electromobile Co., Ltd., of Curzon Street, W., whose electric broughams have become a feature of the West End are now turning their attention to delivery vans, and have lately supplied a neat vehicle to V. Benoist, of Piccadilly, W.

Argentine Republic.—Quite a large number of electric motor broughams are now in use in Buenos Ayres, where several well-equipped garages and accumulator charging stations have recently been established with the view of hiring out such vehicles; a company has lately been formed in the city, under German auspices, and with the title La Compania Nacional de Carrujas Electromoviles.

Italy.—A company has first been formed in Turin with a capital of £36,000, and the title La Societa Automobile Krieger, to build electrical motor-cars on the Krieger system in Italy.

Agricultural Machinery.—At the annual Highland and Agricultural Society's Show in Glasgow, there were a number of interesting exhibits of electrical plant suitable for agricultural purposes.

Messrs. Carrick & Ritchie, Edinburgh, had one of their combined turbines and dynamos, which, by the addition of an improved governor, allows the lamps to be run direct from the dynamo, no accumulators being necessary. This plant is suitable for driving thrashing or other machinery, and ventilating fans. The "Acme" Engine Co., Ltd., Shettleston, had a horizontal oil engine of 40 b.h.p. coupled to a dynamo and fitted with electric ignition; this was arranged to work with producer gas, and has been sold to the Highland Railway Co. for the purpose of generating electricity at Dornoch Hotel.

Santo Domingo.—In a recent dispatch, the British Consul reports that there is an opening for the building of a railway connecting the southern ports with the interior, where there are valuable forests of hard woods and pines. Other enterprises which would pay, would be the construction of an electric tramway in the same city, and the establishment of wireless telegraphy locally and in connection with the new stations in Puerto Rico and other islands.

Outings.—On Saturday last both the Bankside and Sumner Street Works of the Sturtevant Engineering Co., Ltd., were shut down for the employés' annual outing, the venue being Hastings. The party left London Bridge at 8.15 a.m., arriving at Hastings at about 10.30. They were met at the station by a number of brakes and taken for a drive in the country to Battle, returning to the Cricketers' Hotel about one o'clock for dinner. At this function, after giving the toast "The King," Mr. Gurry proposed "Success to the Sturtevant Engineering Co.," and tersely referred to the success and advancement of the Sturtevant Engineering Co., and to the greatly increased manufacturing facilities which they now have in this country, referring particularly to Bankside and Sumner Street Works. The toast was responded to by Mr. Brooker. Mr. Holder (secretary) then read the report, which was satisfactory to all present. The party subsequently enjoyed the various amusements to be found in Hastings, some of them forming small boating parties, after which the whole party partook of tea. Some returned by the 7.30 p.m. train to London Bridge, and the remainder by a later train, after having spent a most enjoyable day, the weather being all that could be desired.

Fire.—One of the most complete installations of electrical apparatus for medical treatment in Scotland, was hopelessly destroyed by fire recently at the Peebles Hydropathic. Hundreds of visitors annually came to Peebles to receive special electrical treatment.

Trade Announcements.—Messrs. Johnson and Phillips, of Charlton, Kent, have appointed Messrs. Guthrie Bros. and Ogilvy, of Prudential Buildings, Newcastle-on-Tyne, their sole representatives for the Counties of Northumberland, Durham, Cumberland and Westmorland, with a view to giving increased attention to their business in that district.

The offices of Siemens Electric Appliances, Ltd., have been removed, as from July 1st, 1905, to 12, Queen Anne's Gate, Westminster, to which address all future orders and correspondence should be directed.

Mr. F. W. Carpenter has opened an office and show room at 8, Cecil Court, Charing Cross Road, W.C., where will be kept a complete stock of Van Raden's woven glass accumulators, induction coils, magnetos, and other motor-car accessories. All orders for these goods should now be sent to this office, instead of to Coventry.

The Dover business of Messrs. Lea & Warren, electrical engineers, of Kettering, has been purchased by Mr. L. T. Young, who will carry it on under the style of L. T. Young & Co.

Mr. H. Moss has been appointed manager of the business of the Meteor Electrical Engineering Co., 44, Swan Arcade, Bradford, and the company will be pleased to be favoured with manufacturers' latest catalogues, price lists and discount sheets.

Correction.—The notice in our last issue concerning Mr. Oubridge should read:—"Mr. E. T. Oubridge has been appointed agent for cables, &c., for London for Messrs. I. Frankenburg and Sons, Ltd."

The branch business at Bristol of the India-rubber, Gutta-percha and Telegraph Works Co., Ltd., of Silvertown, has been removed from Clare Street, to 22, Victoria Street.

Sale.—Notice is given in the *London Gazette* of the sale, pursuant to an order of the High Court, of the Lincoln Engineering Works, Chesterfield, on August 1st.

LIGHTING AND POWER NOTES.

Aspull.—The U.D.C. has applied to the B. of T. for a further extension of time for carrying out the E.L. order, which it is proposed to hand over to the Wigan T.C.

Birkenhead.—In a report of the audit of the Corporation accounts for the financial year, 1904-5, it is stated that the Corporation holds £33,661 debenture, and £4,805 consolidated ordinary stock of the Mersey Railway Co., which has been received for compensation, &c., except a small amount specified. The profit on the tramways undertaking amounted to £1,894, which has been added to the renewals account, bringing the total up to £10,550. The accounts of the electric light undertaking showed an income of £13,322. The profit was £2,109. This sum had also been transferred to the renewals account, which now stands at £4,568.

Bishop Auckland.—An agreement to transfer the powers of the County of Durham Electric Power Supply Co. to the Cleveland and Durham County Electric Power Co., has received the consent of the U.D.C. The latter company has a station at Fylands, near Auckland, and contemplates a more energetic utilisation of its powers.

Bognor.—The B. of T. has informed the U.D.C. that it intends to revoke the E.L. order granted six years ago, and has further declined to sanction the transfer of the order to a company. No fewer than five companies are applying for prov. orders for electric lighting in the district.

Brandon.—The County of Durham Electric Power Supply Co. has informed the Council that it intends applying for a prov. order to supply energy in Brandon and Byshottles.

Brentwood.—The U.D.C. has received intimations that the United E.L. and Traction Co. and the Empire E.L. and Power Co. intend applying for Parliamentary sanction to supply energy within the district.

Bristol.—The Corporation Electrical Committee has decided to reduce the price of energy from October next, from 5d. to 4½d. per unit.

Burnham.—The Slough and Datchet Electric Supply Co., intends applying for an electric lighting prov. order for the district.

Caversham.—The Reading Electrical Supply Co. having intimated its intention to apply for a prov. order for E.L., the U.D.C. has decided before taking similar steps, that it will confer with representatives of the company on the subject.

Chertsey.—Messrs. Foote & Milne intend applying for a prov. order to supply energy to Chobham and Windlesham.

Clacton.—No fewer than four companies have notified the U.D.C. of their intention to apply for prov. orders for electric lighting.

Continental Notes.—SPAIN.—Application has been made for a concession to put down a plant to utilise the water power of the river Pedroso at Fuentelbaul (Burgos), for the generation of electrical energy for lighting and power purposes.

ITALY.—A company has just been formed in Verona with a capital of £12,000, and the title of La Societa per l'Impianto della Luce Elettrica, to establish and work a central electric lighting station in the town.

La Societa delle Tramvie e Ferrovie Elettrichi di Rome has secured a concession to utilise the water power of the river Mariana at Grottaferrate, for the generation of electrical energy.

Dorking.—A L.G.B. inquiry into the U.D.C.'s application for a loan of £12,000 for E.L. purposes was held on July 4th. There was no opposition, but the inspector criticised the increase of 25 per cent. on the estimated cost of the buildings.

Dublin.—On the 10th inst. a resolution was passed by the Corporation in favour of extending the electric lighting system in the city at a cost of £100,000, and the L.G.B. will be approached for sanction to a loan.

Dunfermline.—This week a test was made at the new generating station of the Fife Electric Power Co. at Townhill, and it is expected that consumers will shortly be supplied.

Edinburgh.—The surplus on the past year's working of the E.L. department is £21,140.

Erith.—The U.D.C. has decided to supply energy for motive power in the daytime at a flat rate of 1½d. per unit.

Folkestone.—The local electricity supply company is to extend its powers to Cheriton.

Frome.—The U.D.C. has applied for a loan of £11,000 for electricity purposes. The demand for energy is unprecedented for a town of the size of Frome, and, according to a local paper, Mr. Medhurst, the Council's consulting engineer, states, that the number of units now being sold equal that at Exeter.

Glasgow.—The Electricity Committee's report for the year ending May 31st last show that the gross revenue amounted to £186,372, and the working expenses to £71,721, and after deducting interest on loans, amounting to £38,182, and £15,475 for the sinking fund, there remains a balance on the year's working of £60,993. From this total there has been deducted £2,876, being the proportion of the cost of lamps and fittings supplied to consumers consequent on change of voltage, and the net balance over expenditure is thus £58,117. Of this balance the Committee has decided to write off £41,841 in name of depreciation from the several items of the capital account, being £7,726 over the ordinary amount written off, which would be £34,114. The depreciation is at the same rates per cent. as last year, with additional depreciation on the machinery and plant in Waterloo Street, Port Dundas, Pollokshaws Road and Kelvinside stations. This left a surplus on the year's operations of £16,277, from which £3,554, the sum at debit of profit and loss account brought forward from last year has been deducted and there remains a sum of £12,723. The revenue account continues to show favourable results. The income has increased by £28,181, while the working charges have risen by £10,982. The cost of generation and distribution shows a slight decrease in proportion to the quantity generated, the economy showing principally in the items of fuel and repairs. The result of the increased revenue and relative reduction of costs is that the balance on the year's ordinary working is £60,993, as compared with £45,222 last year. The capital expenditure during the year amounted to £125,115, making the total capital expenditure as at May, 1905, after deduction of the depreciation referred to, £1,244,163. One interesting feature in connection with the increased revenue is the large sale of energy for power. Energy is supplied for power purposes to all classes of trades, but principally to the engineering and iron trades. Many consumers in these trades have discarded steam more or less in favour of electricity. The favourable results of the year's operations have justified the Committee in proposing a substantial reduction in the charges for energy used for private and stair lighting purposes, and the rates have been reduced from 6d. and 1d. on the maximum demand system to 3½d. for the first two hours and 1d. thereafter. For stair lighting purposes the charge has been reduced from 25s. to 15s. per annum, while the charges for motive power purposes remain as last year. The number of units sold to private consumers during the past year was 16,642,253, as compared with 13,604,119 during the previous year, an increase of 22·36 per cent.

Gomersal.—The Yorkshire Electric Power Co. has informed the Council of its intention to apply for a prov. order for the district, but before giving assent the Council has decided to interview the company's engineer.

Gorton.—The U.D.C. has decided to accept the terms of the Manchester Corporation Electricity Committee to supply and maintain "Gilbert" arc lamps in certain streets at £8 each per annum.

Govan.—The report for the year of the Corporation Electricity Department shows a credit balance of £411. The energy sold during the year amounted to 1,086,006 units as against 894,702 units in the preceding year. The total capital expenditure to date is £85,206.

Halesowen.—A prov. order for E.L. is being applied for by the Empire E.L. and Power Co.

Harrogate.—The working of the electrical department during the last 12 months has resulted in a net profit of over £3,000, after meeting all working and financial charges, and placing £500 to the reserve fund.

Hastings.—The T.C. has applied to the L.G.B. for a loan of £2,000 for electricity purposes. Of this, £1,100 is for meters, £600 for transformers and £300 for instruments.

Horwich.—The U.D.C. has consented to Bolton supplying energy within its area, until such time as the Council can effect a supply itself.

India.—BOMBAY.—A recent issue of the *Bombay Government Gazette* contains 3⅓ pages of particulars concerning the licence for the supply of energy within the city, town and island of Bombay for all purposes save electric traction, to the Brush Electrical Engineering Co. The area of supply covers the whole of the municipal area, with the exception of every cantonment, fortress, arsenal, factory, dockyard and camp, and building or place in the occupation of Government for naval or military purposes situate within, or partly within such area. There is a smaller compulsory area within which mains must be laid and distribution commenced within two years from the granting of the licence. Considerable latitude is allowed to the licensees with regard to the system which they may adopt. Clauses cover (*a*) the right of purchasing the undertaking from the licensees by the Corporation or by the Local Government, which is only exercisable at the end of 42 years from the commencement of the licence or at the end of each subsequent period of 10 years; (*b*) the right of the licensees to transfer the whole of the undertaking for which the licence is granted, to a limited liability company, subject to the Local Government being satisfied with the financial status of the purchasing company; and (*c*) a maximum scale of charges for any amount up to 40 units for all purposes, 20 rupees, and for each unit over 40 units, 8 annas per unit.

LAHORE.—The conversion to electric driving of the Lahore locomotive workshops of the North-Western (State) Railway is at last to be commenced. A start is being made on a moderate scale, but large extensions are to be carried out. The plant, now under consideration, for which tenders will very shortly be invited, comprises two 120-KW. generators, high-speed engines, water-tube boilers and the usual power house equipment and accessories, including an induced draught plant. There is some 120 B.H.P. of motors for the machine shops, four 40-ton cranes and sundry portable electric tools for a large new erecting shop, now being built. The supply is direct current at 440 volts. Further large extensions are in immediate contemplation, which will include two 250-KW. units, some 800 B.H.P. of motors, and six electric travellers of 5 and 10-ton capacity. A large expenditure on machine tools is also under consideration, the intention being to more than double the present output of the Lahore shops. This expenditure is urgently called for by the fact that the present facilities are quite inadequate for the needs of this great railway system, which operates over 4,000 miles of open line, and on which the volume of traffic has, during the last three or four years, advanced with great rapidity. The electrical engineer to the railway, Mr. G. E. Wright, is on his way home.

Ipswich.—On July 7th a L.G.B. inquiry was held into the application of the T.C. for loans of £2,438 for a 360-H.P. set, extension of the switchboard and pipework, &c.; and £12,851 for other electricity purposes. There was no opposition.

Kirkcaldy.—The deficit on the tramways for the past year was £1,500, and on the electric lighting £400.

Ledbury.—The U.D.C. has decided to take no action with reference to Messrs. Foote & Milne's application for a prov. order for electric lighting.

London.—ST. PANCRAS.—Owing to the fact that the Administrative Power Bill proposes supplying energy for power purposes on a scale of charges which undercuts the B.C.'s tariff from 5 hours' use per day and upwards, the Lighting Committee

proposes to amend its charges as follows:—(*a*) That the present rate of 1d. per unit for energy for motive power be amended by the adoption of the following scale of charges:—From 1 to 5 hours' daily use, 1d. per unit; 6 hours, 0·94d.; 8 hours, 0·83d.; 10 hours, 0·76d.; 12 hours, 0·72d.; 18 hours, 0·64d.; and 24 hours, 0·609d. (*b*) That from August 1st, 1905, proprietors of factories using energy for power purposes, be allowed to light their premises at 1d. per unit up to 20 per cent. of the units they have used for power.

Fulham.—The B.C. intends shortly to apply to the L.C.C. for a loan of £63,328, to be taken up in three instalments, for electrical works.

Hackney.—The Electric Lighting Committee of the B.C. has resolved, subject to the usual sanction, to adopt, as a revised rate for power supply, a fixed charge of £1 per quarter per kw. of maximum power required, and ½d. per unit for energy supplied. The annual progress of the power demand in Hackney has been as follows:—At March 31st, 1902, 11 motors of 24 h.p.; 1903, 48 motors of 260 h.p.; 1904, 178 motors of 614 h.p.; 1905, 223 motors of 797 h.p.

The Committee having studied the various electrical power Bills, has noted that the prices scheduled have been based on a sliding scale dependent upon the number of hours' use of the maximum demand, and the system is similar to that on which the charges at Hackney are based.

Islington.—At the meeting of the B.C. on Friday last, the Lighting Committee brought forward the following recommendations:—(*a*) That the present sliding scale of 7d. per unit for the first hour's daily use of the maximum demand in the quarter, and 4d. per unit for all consumption beyond, be altered to a sliding scale of 7d. and 3d. per unit respectively. (*b*) That the present uniform rate of 5d. per unit for lighting be reduced to 4d. per unit. (*c*) That the price of electricity to private consumers for arc lighting purposes be 3½d. per unit. (*d*) That the present rates for the supply of electricity for power, heating and cooking purposes be altered from 2d., 1½d. and 1½d. to an uniform rate of 1d. per unit. (*e*) That the time limit in the case of supply of electricity for power be abolished and that the rate be uniform throughout the 24 hours. (*f*) That a discount of 2½ per cent. be allowed on all quarterly accounts exceeding £5, and of 5 per cent. on all quarterly accounts exceeding £10, provided such accounts are paid within 14 days of presentation. (*g*) That the foregoing charges take effect as from the end of the next September quarter. A long debate ensued upon a proposal to refer back the whole matter so that reports from the borough treasurer and the electrical engineer might be submitted, showing the effect of the proposed reductions upon the financial position of the electric lighting undertaking. It was argued that it was essential that reductions should be made at once to fight the Administrative Co.'s proposals. One member, however, ventured to welcome a company which could supply for 1d., energy which cost the Council itself 3d. per unit. The amendment to refer the matter back was eventually carried by a large majority.

Stepney.—The B.C. has ratified an agreement with the Administrative County of London Power Co., whereby the Council's opposition to the company's Bill is compromised or withdrawn. The principal heads of the agreement are as follows:—The Council—(*a*) To use all the energy which the plant that the Council's station is capable of accommodating, will produce. (*b*) To supply any consumer within the Council's authorised area of supply except railways. The Company—(*a*) To supply, in bulk, the energy that may be required by the Council beyond this. (*b*) To supply railways only. It is further agreed that the Council may require the company to purchase a portion of Blyth's Wharf, which has been acquired as a site for another generating station. The Council has also, under the terms of the compromise, the right of asking the Board of Trade for a reduction in price at the end of each period of five years. The terms are to remain in force for a period of 50 years. In the event of the Council determining the agreement, it is to pay the company such sum as may be required to cover the unredeemed portion of the special plant and mains used to supply Stepney, the life of the plant being taken as 25 years. The company has undertaken to pay the Council's taxed costs of its opposition to the company's Bill in the House of Lords. The fulfilment of the above is subject to the passing into law of the company's Bill.

Westminster.—The Charing Cross Co. has agreed to supply energy to the Council at 2½d. for lighting and 2d. for power, for three years, and a contract is to be entered into on these terms.

L.C.C.—At the meeting on Tuesday it was resolved to advance £8,830 to the Battersea B.C. for electric lighting purposes, and £6,796 to Bermondsey for extension of works.

Manchester.—From the annual report of the E.L. Department, we gather that the total output of electricity from the Corporation works during the past year ending March 31st reached the high figure of 41,170,721 units, or 8,559,799 units more than in the previous year, the increase being 22·17 per cent. The quantity measured and accounted for was 36,979,552 units, showing a difference of 10,191,169 units, or 21·60 per cent., being the quantity used in distribution or otherwise not accounted for. The mains laid up to March 31st last measured 292 miles 165 yards. The income last year reached £302,200, including £182,560 for lighting and power, and £117,590 for traction. The working expenditure was £174,320, and, after interest on the mortgage debt and the sinking fund have been provided for, there remains a net surplus of £4,544. The reserve fund at the beginning of the financial year stood at £32,561, but now only amounts to £20,387, the decrease being mainly due to expenditure in respect of vibration and explosion lawsuits. The capital outlay shows a total at March 31st, 1905, of £2,199,689.

Application has been made to the L.G.B. for further borrowing powers to the extent of £60,000, for additional machinery to be erected at several of the distributing sub-stations.

It is proposed to reduce the price of energy supplied for lighting purposes, and the Council will be asked to sanction a reduction to short-hour consumers from 5½d. to 4½d. per unit, to take effect from September 29th next. An agreement has been entered into with the Gorton U.D.C. to take over its prov. order for the supply of electricity in that district.

At the Dickinson Street generating station, substantial progress has been made with the erection of the two 750-kw. Parsons-Siemens turbo-generators. These sets will supersede several belt-driven sets of smaller size, which have been sold. The erection and equipment of the additional 12,000-h.p. installation at the Stuart Street generating station has made steady progress; the two 6,000 h.p. generators are practically complete and ready for running. A large number of feeder-ducts are being laid from Dickinson Street works to various parts of the city, in readiness to meet the increased demands for next winter.

Market Harborough.—A private company having informed the U.D.C. that it intends applying for a prov. order, the Council has intimated that it will oppose any such application.

Melbourne.—The *Sydney Daily Telegraph* of May 26th states, in reference to the maximum demand system of charging for electric light, that a writ has been issued against the City Corporation on behalf of the Metropolitan Gas Co., claiming an injunction to restrain the Corporation from charging for energy except at uniform rates.

Middlesbrough.—The E.L. Committee reports to the T.C. that the net profit on the electricity undertaking for the past year amounts to £766.

Motherwell.—The T.C. has agreed to the following reduction in charges to consumers: That all energy for power over 25,000 units per quarter be charged at the rate of ¾d. per unit.

Newport.—In reply to the South Wales El. Power Distribution Co., which is anxious to supply certain consumers within the area at ¾d. per unit, the E.L. Committee states that it is not prepared to give its consent, being itself in a position to furnish a supply on reasonable terms.

Oakengates (Salop).—Messrs. Baker, Lees & Co. have informed the U.D.C. that they intend applying for a prov. order for electric light on behalf of the Shropshire and Worcestershire Electric Power Co. The Council has decided to take no action in the matter.

Pontefract.—A prov. order for E.L. is being promoted by a private company.

Provisional Orders.—The annual report of the B. of T. for 1904 shows that 74 prov. orders were applied for, 65 made by the Board, and 57 confirmed by Parliament. Since 1882, 1,171 orders have been applied for, 925 made, 909 confirmed by Parliament, and 172 revoked or repealed.

Redcar.—The U.D.C. has declined to treat with the United Electric Construction Syndicate with respect to the latter taking over the Council's E.L. order, obtained four years ago; it is now negotiating with the Cleveland and Durham County Electric Power Co. for a supply in bulk.

Sheffield.—Mr. S. E. Fedden has issued a pamphlet on the prevention of down draughts in public buildings, and invites inquiries from places within the borough suffering from this inconvenience. By suitable disposition of electric radiators, this can be easily and cheaply overcome.

Southport.—Flame arc lamps are to be substituted for the present arc lamps in Lord Street, which have been in operation 10 years. The standards have been raised an additional 3 ft. 6 in., and considerable alteration to the present arc lighting mains has been necessitated.

Sowerby Bridge.—The B. of T. has sanctioned a supply of energy in bulk being obtained by the U.D.C. from the Yorkshire Electric Power Co. for the purpose of carrying out the E.L. order.

Spennymoor.—The U.D.C. has accepted the tender of the Northern Counties Electricity Supply Co., for lighting the district for one year at £2 5s. per lamp. Two gas companies tendered at £2 19s. 6d. and £3 per lamp respectively.

Sudbury.—Acting on counsel's opinion, the T.C. has decided not to appeal against the decision in the recent law action against the Empire E.L. Co., and has paid the taxed costs of the company, which amount to £79.

Swansea.—The Corporation E.L. and Tramways Committee has recommended the T.C. to refuse permission to the South Wales Electrical Power Distribution Co. to supply energy for power purposes to works within the borough, at ¾d. per unit.

Swindon.—The T.C. has authorised extensions of the E.L. mains at an estimated cost of £3,921.

(*Continued on page* 63.)

THE CALCUTTA ELECTRIC TRAMWAYS.

The Calcutta Tramways system is the largest and most important of the tramway systems in the East, and it possesses more than usual interest, having regard to the conditions under which it operates.

The city lies low, and an extensive system of artificial drainage has been adopted. This, however, is not nearly sufficient to cope with the extraordinary downpours during the rainy season, which flood the streets in certain sections of the city for the greater part of the day, sometimes to a depth of 2 ft. Further difficulty is encountered from the severe wind-storms, approximating to cyclones, which sweep over the city at the beginning and the close of the rainy season, which lasts from the middle of June to the end of September.

Calcutta is divided into three natural parts :—The European business district; the native residential and business district; and the European residential district.

The total population, with certain adjoining suburbs, is about 1,000,000, but this does not include the municipality of Howrah, located on the opposite side of the Hooghly River, with a population of 157,594, nor two other suburbs which will soon come within the tramway zone, and which have an additional population of 51,806. The total population can thus be put down at 1¼ million.

In the native town the streets are narrow and densely peopled, but the southern European residential area is traversed by wide and well paved roads.

The first tramway company was registered in England on December 23rd, 1880, and operated its system by steam trains on the Kidderpore section, and horse cars on the remaining section, until 1901, when the original concession expired. In 1899 an agreement was entered into with the Corporation, whereby the company was granted a new concession for 30 years from January 1st, 1901, in consideration of the conversion of the system from horse to electric traction within three years.

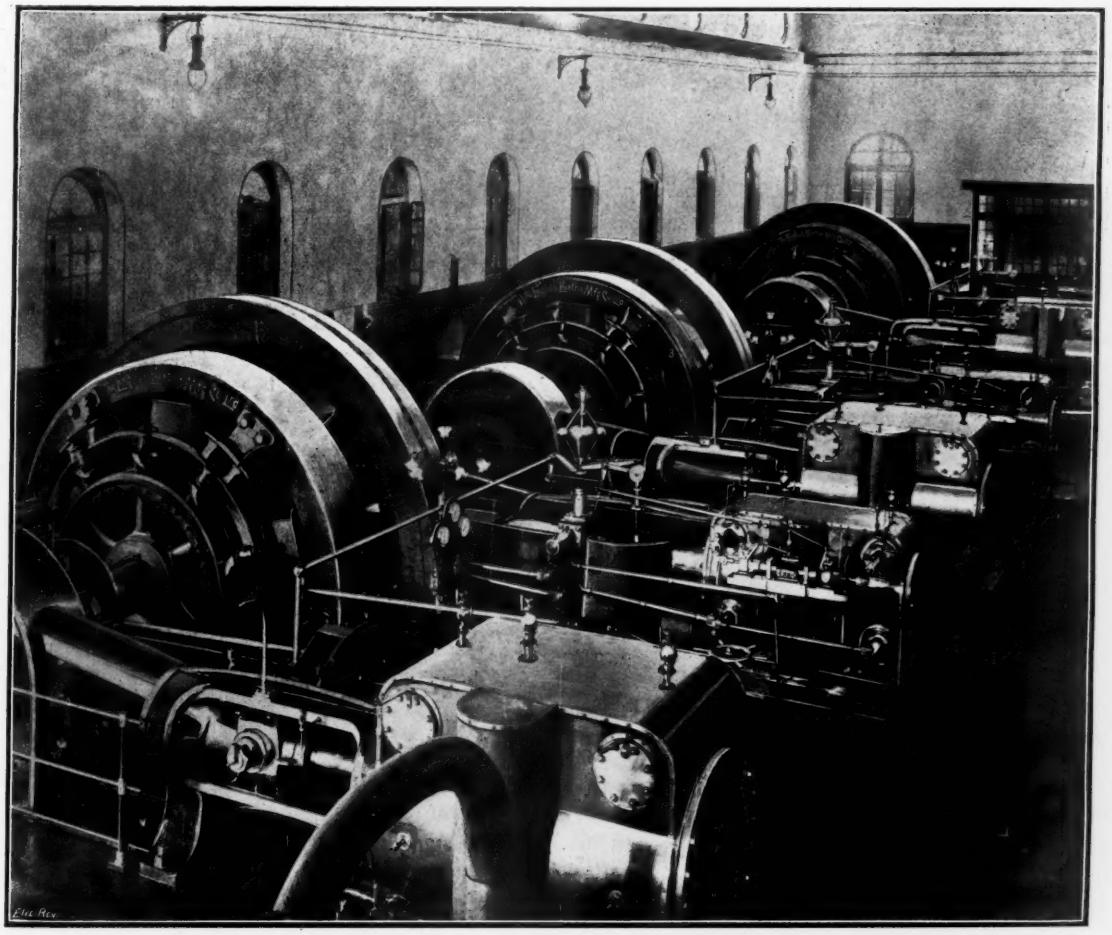


Fig. 1.—General View of Engine Room, showing Yates & Thom—Dick Kerr Generating Plant.

The electrification of the system was undertaken by Messrs. Dick, Kerr & Co., of London and Preston, who carried out all the work except the buildings and the reconstruction of the permanent way, this being done by the company itself. All the rails, iron work, bonds, &c., for the permanent way work, were, however, furnished by the above firm.

The present tramway routes, covering a total length of 23 route miles (double track throughout), all radiate from one small section of the city, where the majority of the Government offices and European business houses are located. The cars on the various lines are run to either one of two termini, one being at the loop near the High Court, and the second, the Esplanade Junction, shown in fig. 4,

which forms the connection between the northern and southern lines. The number of cars at these two points during the rush hours is very large, amounting on a average to: High Court, 750; Esplanade junction, 1,150.

The northern section of the city is served by three routes; the central portion by three; and the southern portion (including suburbs) by two, all double track.

Fig. 2.—Calcutta Tramways Power Station.

There are eight main routes, and these, with two exceptions, can be considered city lines. The Chowringhee line runs southward to a densely populated suburb, Bhowanipore, touching upon the way the western extremity of the European residential zone. On this route is also located a famous Hindoo temple, which attracts a constant native traffic throughout the year, and during certain holy festivals the service has to be doubled to cope with the rush.

The line to Kidderpore which feeds the populated suburb which lies to the south near the river, caters for the large traffic between the extensive docks and Calcutta, and derives a large traffic from the race meetings which are held on the Maidan.

The first line under electric traction in Calcutta was open for regular service on March 27th, 1902, and the entire system was operated electrically on November 20th, 1902. An exceptionally large increase of traffic, immediately followed the opening of each section, which, however, was to be expected, since under the steam and horse traction, there was only one class of passengers. Owing to the severe climatic conditions of excessive heat and humidity prevalent in Calcutta during the summer months, and the consequent exhaustion of the horses, even this second-class service was not nearly sufficient to cater efficiently to the riding public. The total traffic revenue increase with electric traction over that of horse traction, after two years of operation, is about 75 per cent.

When converting from horse to electric traction, it was decided to adopt the train system, consisting of one motor and one trailer car; the former serves first-class passengers represented by Europeans and well-to-do natives who previously never made use of the tramways, and the latter provides accommodation for the old patrons. This system made it necessary to construct loops or triangles at various points on the routes for the turning of the trains.

The car service, or rather train service, regulated carefully according to requirements, begins at 5 a.m. and ends at 10.30 p.m. The native being an early riser, traffic begins quite briskly in the morning, takes a sudden rise at 9.30 to 11 a.m. during the office traffic, falls off during the afternoon, increases rapidly again at 4.30 for the return office traffic, and is practically finished at 9.30 in the evening, since the native travels about but very little at night.

The maximum number of trains that is operated at the same time during an ordinary week-day, on the present 46 miles of track, is 132; this number is increased to 145 on race days, and during the Pujah festival of the Hindus (which corresponds to some extent with our Christmas in importance), the then full equipment of 151 trains was required, the traffic to the temple at Kalighat from all parts of the city, being very large.

The traffic staff is all native with the exception of the superintendent and his two first assistants, who are Europeans.

A few traffic results are herewith given, which are of interest for comparative purposes with those found in the West:—

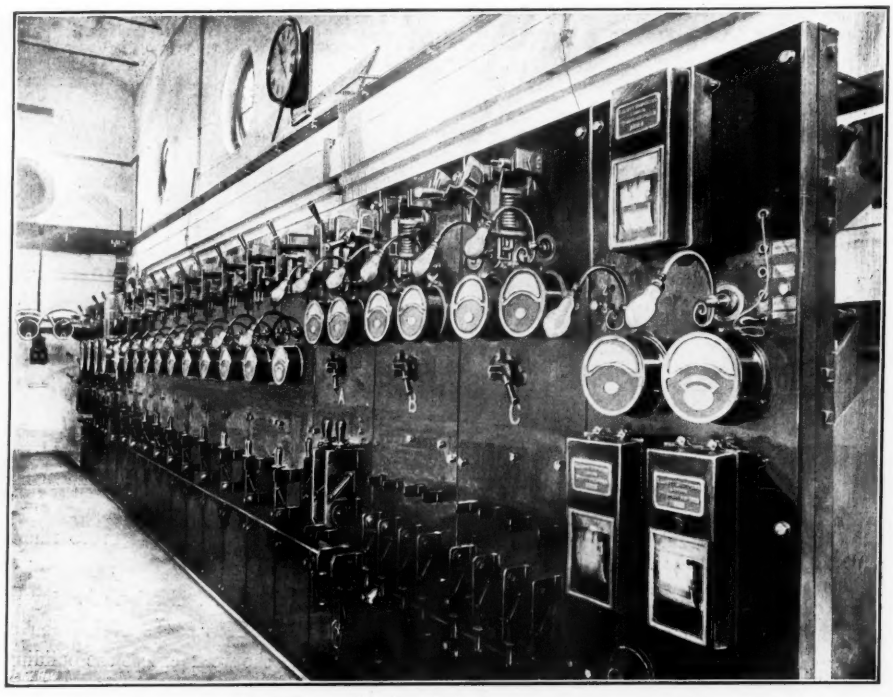


Fig. 3.—View of the Main Switchboard.

Total number of passengers carried per year...	21,000,000
Total yearly train-miles run	3,300,000
Passengers per train-mile	6·4
Average distance travelled per passenger ...	2 to 2¾ miles
Average fare per passenger	1·46d.
Traffic operating expense per train-mile ...	1·25d.

The operating expenditure per train-mile of about 1·25d. includes salaries and expenses for the

superintendent, assistants, motormen and conductors, regulators, starters, cashiers, &c.

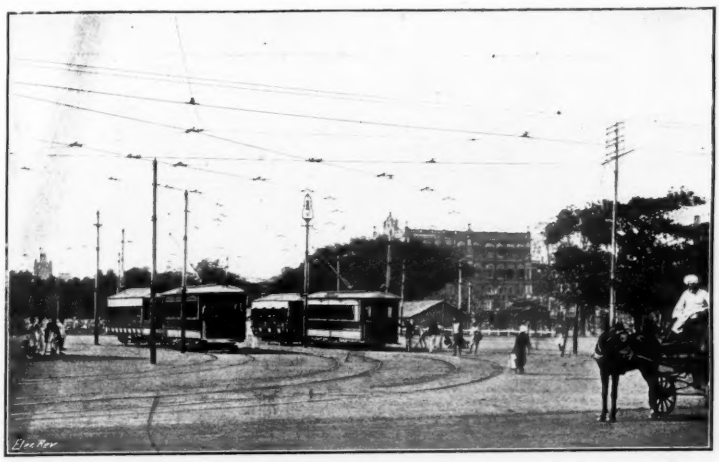


Fig. 4.—Calcutta Tramways: Esplanade Junction.

A considerable portion of the track in the early days of the company was single with turnouts. This was found to be very unsatisfactory, and it was therefore gradually doubled throughout, the last route dealt with being the Kidderpore section, just before the introduction of electric traction.

The gauge of the track is the standard 4 ft. 8½ in. The girder rail was substituted for the old box rail throughout, the weight being on the first sections 95 lb. per yard, with ¾ in. and ⅞ in. groove, and on the more recent sections a 101 lb. rail with 1⅛ in. groove. The usual tie-bar construction is employed, five bars being provided on an average, per rail length of 30 ft.

Two No. 0000 B. & S. Neptune bonds are used for every joint, and the track is adequately cross-bonded.

The rail is bedded on a lime concrete stringer, having a width of 16 in. and a depth of 9 in. This concrete is made up of 10 parts of broken brick, three parts of ground brick and two parts of slaked lime; this method of making up concrete is prevalent in Calcutta, since broken stone is expensive and the high price of Portland cement prohibits its use in this connection.

The edges of the rails on all lines in the city are paved to a width of 18 in. on the outside of the double track rails and 9 in. on the inside, Indian granite setts being used. In some streets and parts of streets where the track is especially heavy, paving is carried across the double track to a distance of 18 in. on the outside of the extreme rails. The setts are bedded in sand and grouted with four parts of river sand and one of Portland cement.

In its agreement with the Corporation, the company undertakes to keep the roadway in proper repair within the distance of 18 in. on the outside of the extreme rails.

The system is worked throughout by means of the overhead trolley, and on account of the peculiar conditions existing, a part of the lines had to be equipped for side-running.

The poles used are of steel tube, built up of three sections, socketed into each other; the average distance between the poles varying from 100 to 120 ft. on the straight.

The brackets on the side-running portions vary in length, from 3 ft. for centre pole to 15 ft. in side pole construction.

The trolley wire is of hard drawn copper of 000 S.W.G. gauge, and is generally supported by double insulating hangers of the rigid suspension type; the flexible suspension has been substituted on that section of the Chowringhee lines, where the speed attained is greater than the average, so as to lessen the effect of the blow on the ears. A similar improvement will be made on the Kidderpore line.

The majority of the feeder cables are led to the central point of the city, where all the lines converge. There are nine positive feeder cables, varying in cross-section from ·19 to ·6215 sq. in., which connect up the power house to 43 feeder and section pillars distributed over the various routes. The negative cables are three in number, one of

Fig. 5.—View on Route: Native Quarter.

Fig. 6.—View on Route: European Quarter.

them having a cross-section of ·7942 sq. in., and the other two, ·3 sq. in. each.

These cables are paper-insulated and lead sheathed, and were laid underground in cast-iron troughs on the solid system, although in all future cable laying, earthenware troughs are to be used. The cables used for connecting from the feeder pillars to the trolley wires are 61/17 S.W.G. rubber-insulated, heavily braided and lead covered. The feeder pillars themselves are in the form of a cast-iron box, which is raised 2 ft. above the ground in those places where there is danger of flooding, due to the rains. Each pillar contains the usual standard switches and connections mounted on a marble or slate switchboard.

At present there are 171 single-deck motor-cars, of which 96 are of the open type, and 75 of the closed type. The motor-car bodies and equipments were made at the Preston works of Messrs. Dick, Kerr and Co., and the trucks were furnished by Messrs. J. G. Brill & Co.

The car-bodies are of plain strong construction, made to suit the climatic condition, teak wood being used throughout, owing to its being impervious to the ravages of white ants. The closed cars each have a total seating capacity of 27.

The open-type cars, each of which has a seating capacity of 40 passengers, are single-ended, with the entrance from one side only, this being dictated by the loop system that was adopted.

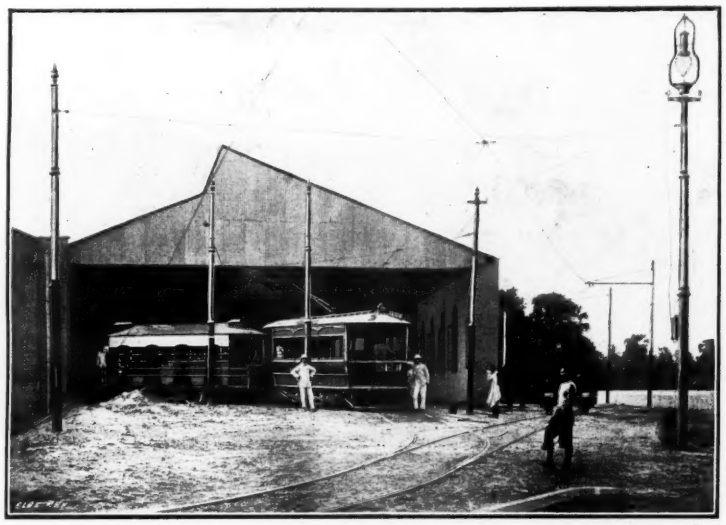


Fig. 7.—View of Car-Shed: Tallygunge.

BOWBAZAR
FORT WILLIAM
BOWBAZAR
HOWRAH
BOWBAZAR
HOWRAH
BOWBAZAR
HOWRAH

The three large generators are of the contractor's standard direct-coupled continuous-current railway type; the normal output of each being 500 KW. with a pressure of 550 volts. Each of these generators can safely carry 25 per cent. overload for an hour without injurious heating; the efficiency being about 95 per cent. at full load, and 93¾ per cent. at half load. The generator, which is coupled to the smaller engine unit, has a capacity of 150 KW., the general arrangement and mechanical and electrical features of this machine being similar for the larger units.

The condensing plant is located in the basement of the engine room, and consists of a surface condenser of sufficient capacity to deal with the exhaust from all three main engines, together with two steam-driven air-pumps (each having a capacity of two units), and two electrically-driven centrifugal circulating pumps, each pump being capable of discharging 72,000 gallons of water per hour through the condensers and up to the water inlet on the cooling towers. The latter pumps are each direct coupled to a 35-H.P. motor. This plant, in conjunction with the cooling towers, will condense 36,000 lb. of exhaust steam per hour. This gives a vacuum of 21 in. to 22 in. in the condenser during the cold season when the atmosphere is dry. During the rains, however, the humidity in the atmosphere is large, and, in consequence, the efficiency of the cooling towers is very much reduced, making it possible to attain a vacuum of only 18 in. to 19 in. with maximum load on the station.

At present there are two towers, with fan draught, installed for the purpose of cooling the water from the condensers, one being of Klein's patent type, and the other, which was recently installed, being of the Zschocke type.

The switchboard is constructed of enamelled slate panels, and is placed on a gallery at one end of the engine room. There are four generator panels, one main output panel, ten feeder panels, one lighting panel, one motor panel, three negative booster panels, and one Board of Trade panel. A general view of the board is shown in fig. 3.

For assisting the rail return, so as to comply with the regulation that no part of the track return shall show a greater drop than 7 volts, three boosters have been installed, connected to the track by insulated return cables. These boosters have a respective capacity of 800 amperes at 80 volts, 300 amperes at 120 volts and 300 amperes at 70 volts.

The engine room is spanned with an overhead crane, designed to lift 15 tons, and operated by hand.

In the boiler room there are installed six boilers of the Galloway (Lancashire) type, 30 ft. × 8 ft. in diameter, each containing two furnaces joined into one Galloway flue, the furnaces being 3 ft. 3 in. in diameter. To the above plant has just been added one B. & W. boiler, which will form part of the large extensions to the entire plant referred to below.

In connection with the boiler plant, a Green economiser, consisting of 480 tubes, is arranged in the main flue.

Three Weir's patent direct-acting boiler feed-pumps are provided, each having ample capacity to feed four of the boilers, thus leaving one in reserve for the present nominal output of the power house. Each pump is capable of delivering to the boilers 30,000 lb. of water per hour.

Ample coal storage is provided in the bunkers, which face the boiler fronts, the storage being sufficient to operate the plant for a month.

Four car-sheds have been erected, these being located at various extremities of the system.

The principal shed is situated on the same premises as the power station; adjoining it are the workshops, smithy, foundry, paint and wood-working shops, armature-winding department, &c.

To provide sufficient power for the steadily increasing traffic demands on the existing lines, and also for the tram service on Harrison Road and several new suburban lines which will be opened in the near future, the power station is being considerably increased, and three-phase alternating current generators are being installed, generating at 6,600 volts pressure; energy will be transmitted to several rotary convertor sub-stations in outlying parts of the city by means of duplicate three-core cables, laid separately on the solid system, in earthenware troughing.

LIGHTING AND POWER NOTES.

(*Concluded from page 58.*)

Torquay.—The L.G.B. has written to the T.C. with reference to the application by the latter to borrow £42,000 for E.L. and power supply purposes, stating that the Board adheres to the view that the T.C.'s proposals would involve a serious loss to the borough. The difficulty in which the T.C. is placed in consequence of its agreement with the Dolter Electric Traction Co. is realised by the Board, but it states that the company might be willing to enter into an arrangement whereby the Council would be relieved of its obligations, and suggests that negotiations should be opened to this effect.

Trowbridge.—The Western Electric Distributing Co. has informed the U.D.C. that it intends laying cables for electric lighting in the town.

Tunbridge Wells.—Consumers are petitioning the T.C. to reduce the price of energy from 6d. to a maximum of 4½d. per unit; in addition, a discount to large consumers is asked for. The petition states that, failing the concession, those signing will be compelled to consider the desirability of ceasing to take a supply.

Wakefield.—The past year's working of the Corporation electricity undertaking has yielded a net profit of £1,288.

Walsall.—The L.G.B. has sanctioned the borrowing of £1,350 for the purposes of electric lighting.

West Hartlepool.—The T.C. has agreed to supply energy to the Seaton Carew Iron Works for power purposes. The cost of the requisite mains is estimated at £4,000, but the works will take a million units per year, and the net annual return to the Corporation from the transaction will be between £1,200 and £1,500.

Willesden.—The working of the E.L. undertaking has, during the year ended March 31st last, yielded a profit of £204. The revenue amounted to £13,301, and the expenditure to £13,097, including a sum of £335 for legal charges, &c. The report states that the company has paid to the Council for interest and sinking fund on capital account, an average of 1·083d. per unit sold. As the average price paid throughout the year for units bought was 1·298d., or on the basis of units sold by the Council was 1·598d., the company received ·515d. per unit to cover their costs of production. The estimate of production costs on a somewhat similar output, which was criticised as being unattainable, was 1·155d. per unit. If the difference between this figure and that received by the company (·515d.), amounting to 0·640d., be added, and the total cost of production by the Council be taken at the above 1·155d., the costs are increased by £2,333 5s. 3d., with the result that the profit of £204 would have become a deficiency of £2,129, which has been saved to the ratepayers as the result of the Council having purchased the supply instead of generating for itself.

Wisbech.—The L.G.B. has decided not to grant the application of the Corporation for power to raise a loan of £25,000 required for the purpose of carrying out an electric light scheme. Strenuous opposition to the suggested outlay was forthcoming from a strong minority of the Council, supported by a large body of the ratepayers, when the Government inspector held the public inquiry last September.

Woodbridge.—Messrs. Foote & Milne intimate that they intend to apply to the B. of T. for a prov. order for the district.

York.—From the annual report of the electrical undertaking, we gather that 9,819 equivalent 8-C.P. lamps were added during the past year, making the total connected to the mains 62,293. Some 904,000 units were sold, compared with 776,542 in 1903-4. The revenue from the sale of energy was £10,704, and the gross profit amounted to £5,021. Owing to increased financial charges this year, amounting to £6,850, as compared with £3,799 in 1903-4, a deficit results on the year's working; 147 motors with a H.P. of 660, are now connected up, and 230,677 units were sold for power purposes, compared with 184,427 in 1903-4. The destructor during the past year destroyed 10,657 tons of refuse, compared with 8,664 tons in the previous year.

TRAMWAY AND RAILWAY NOTES.

Ardrossan.—A new electric tramway service is proposed between the golf house at Stevenston and Ardrossan. The promoters are the Electric Traction Co., who are to have a lease for 30 years.

Bath.—The Light Railway Commissioners have granted an order for the construction of the proposed electric railway to run from the suburb of Weston to the top of Lansdown, which is 780 ft. above the sea-level. The scheme will cost £17,000.

Belgium.—A company has just been formed in Brussels, with a capital of £100,000, to be known as La Société du Chemin de Fer Electrique d'Ostende-Blankenberghe et Extensions, to construct and work an electric railway between Ostend and Blankenberghe.

Buenos Ayres.—The first sections of the Buenos Ayres Grand National Tramways are now being operated electrically.

Colne.—The T.C. has granted an honorarium of £75 to the surveyor for special work in connection with the light railway construction.

Dartford.—The ceremony of the laying of the first rails of the Dartford U.D.C. tramways at the terminus of the Bexley Heath tramways took place on Wednesday afternoon last.

Derby.—The working of the tramway during the past 12 months has resulted in the receipts from horse traction amounting to £10,298, and from electric traction to £17,800. The sum of £507 was received for advertising upon the cars, making a total revenue from them of £18,307. The net revenue was £7,620. The repayment of loans and interest absorbed £4,899, leaving a net profit upon the cars of £2,721. The number of miles run by the electric cars was 411,822, and the cost of energy per car-mile was 1·56d. The receipts per car-mile came to 10·31d., and the cost of working was 6·31d. per car-mile. The number of passengers carried on the cars was 4,001,009. The receipts for the last quarter amounted to £8,000, or nearly a half of the whole amount taken since they have been running, and there is every probability of the receipts for this, the summer quarter, exceeding that amount. The opening of the Kedleston Road route will, it is expected, make a big difference to the summer trade.

Ettrick Bay.—The Ettrick Bay extension of the Rothsay tramway lines is now completed. The Board of Trade inspection was carried out on Thursday last week.

Folkestone.—The B. of T. has granted the T.C. an extension of time for carrying out the tramways order.

London.—L.C.C.—The Highways Committee this week brought forward a proposal to reconstruct on the conduit system a portion of the tramways in Woolwich Road at a cost of £23,200. The consideration of a recommendation to this effect was adjourned for a week. In the opinion of the Finance Committee the scheme should be postponed until a project for dealing with the whole of the Woolwich lines had been prepared, but the Highways Committee stated that economy in working would be effected by reconstruction, and that as the existing rails, cars and plant were in a defective condition, they would in any event require shortly to be renewed.

The Council also postponed for a week the consideration of a recommendation to accept the offer of G. Skey & Co., Ltd., to supply 250,000 stoneware cable ducts for £3,193 15s., and that of Stanley Bros. to deliver 500,000 ducts for the sum of £6,800. The ducts are required in connection with the reconstruction of the first sections of the northern tramways, on the transfer of the lines from the company to the Council in April, 1906.

The General Purposes Committee has been considering a scheme for an ambulance service to deal with street accidents within a three-mile radius of Charing Cross. The proposals provide for motor ambulances worked by electricity, and a method of giving calls by means of street call-posts fitted with telephones. The Committee proposes to purchase 10 electric motor ambulances, at a cost of £5,600. One will be maintained at each station, and two or three will be held in reserve. The General Purposes Committee recommends the Council to apply for the necessary powers in the next Session of Parliament.

Llandudno-Colwyn Bay.—A short extension of time for the construction of the light railway from Llandudno to Colwyn Bay has been granted by the B. of T. to the Llandudno and Colwyn Bay Electric Traction Co. No further extension will be granted.

Horwich.—At the meeting of the U.D.C. on July 5th a letter was read from the Preston and Horwich Tramways Co., stating that it intended applying for a further extension of time of a year for the completion of the tramways.

Nagpur (India).—With the consent of the Municipal Committee, an application has been made by Messrs. Crompton and Co., Ltd., for an order authorising the construction of an electric tramway within the municipal area. The duration of the licence would be for 42 years.

Newport.—In the statement of affairs of the Corporation electricity and tramways undertakings for last year a gross profit of £12,695 19s. 3d. is shown. The electricity account shows a surplus for the year of £394 1s. 1d., and the tramways show a deficit of £595 5s. 5d. A number of economies are to be effected during the current year, and energy is to be charged at 1½d. per unit, less a discount of 10 per cent., as against the present charge of 1½d. per unit net.

Nottingham.—The tramways last year yielded a surplus of £20,181 over expenditure, and the passengers carried numbered over 27,496,477. Since 1902 the cars have run over 7¼ million miles, and carried upwards of 80,000,000 passengers. Only one fatal accident has occurred.

Pontypridd.—The T.C. has fixed the charge for energy to the tramways at 1½d. per unit.

Sunderland.—On the 5th inst. the inquiry was concluded into the circumstances of the death of the boy Herbert Curry, the victim of the tramway accident on Whitsun Monday at Silksworth. The jury returned a verdict of accidental death, adding their opinion that the causes of the accident were a defective brake, overcrowding the car, and want of greater caution on the top of the bank. They informally acknowledged that the company was taking every possible precaution in working the cars.

Walsall.—Negotiations are pending between the Corporation and the Birmingham and Midland Tramways Co., for through communication from the Pleck, Walsall, to Darlaston and Wednesbury. Hitherto this has not been practicable, mainly on account of the voltages on the two lines, but it will be possible when the re-equipment of the Wednesbury and Darlaston sections is completed, and, when carried out, should be of benefit to all concerned. A 20-minutes' service to and from the Bridge, Walsall, and the Market Place, Willenhall, is to be arranged. The fares to be adopted on the Willenhall section when the through service is commenced have been fixed.

Wigan.—On Wednesday last week the Government inspection of the Wigan tramway route between Wigan and Standish took place, Col. Druitt, C.E., making the inspection, accompanied by the Mayor, Alderman Johnson, and members of the Corporation.

Wolverhampton.—The Corporation Tramways Committee has issued the abstract of accounts for the working of the tramways undertaking for the year ended March 31st last. The report shows that the total income in excess of working expenses amounted to £15,169 (£37,272 income, less £22,103 expenditure). This has been dealt with as follows:—Contribution to renewals fund, £4,790; instalment of interest, £7,533; repayment of loans, £3,453. Deducting bankers' interest, £801, the balance, being profit for the year, is £193. The Committee states that a general reduction has been effected in the costs of operation and maintenance. An increase in expenditure in respect of maintenance of feeders and conduits is accounted for by the fact that in two cases feeder pillars have been entirely wrecked by collision with some vehicle, of which it has not been possible to trace the owner. The total operating costs are about ½d. per unit less than for the corresponding period last year, and the Committee is of opinion that the figure of 6·55d. per car-mile must be regarded as very satisfactory. The Committee also emphasises the fact that a thoroughly adequate allowance has been made in respect of future renewals. On three of the routes, viz., Willenhall Road, Wednesfield Road and Bushbury, a full year's working has not yet been completed. The Committee also presents the following statistics. The figures in the first column are the results obtained in Wolverhampton, and those in the second column the average of 39 municipal tramway undertakings in Great Britain:—

	Wolverhampton.	Average of 39 undertakings.
Percentage of costs to revenue	59·3%	66%
Percentage of gross profit to average capital	6·9%	6·08%
Passengers per car-mile	9·4	8·9
Journeys per head of population per annum	80	80
Revenue per car-mile	10·898d.	9·75d.
Average fare	1·15d.	1·12d.
Total operating costs per passenger	·69d.	·78d.
Units per car-mile	1·58	1·34
Repairs and maintenance per car-mile (including electrical equipment)	·844d.	1·03d.
Management	·77d.	·92d.
Total operating costs per car-mile	6·55d.	6·75d.

In a report on the question of intercommunication with the outlying districts, from which Wolverhampton has been so long isolated by the Lorain system of traction, the Committee states that it has been in communication with the Wolverhampton and District Electric Tramways Co., Ltd. (the company now controlling the Bilston, Willenhall and Sedgley lines outside the borough), with a view to obtaining a working agreement (involving mutual running powers) under the provisions of the Wolverhampton Corporation Act, 1899. Terms have been provisionally agreed with the company whereby it is proposed to establish a through service of cars between Dudley and Snowhill, Wolverhampton, and between Bilston and Victoria Square, Wolverhampton.

The Corporation cars running to Bilston will be equipped with trolley arms for use on the overhead system outside the borough, whilst the company's cars will be equipped at the company's expense with Lorain skates, &c., to work on the Lorain system on the Dudley Road.

TELEGRAPH AND TELEPHONE NOTES.

Edinburgh.—It is proposed to institute a telephone exchange in connection with the various city departments, and the matter has been remitted to a sub-committee for consideration.

German Telegraph Cables.—The cable steamer *Stephan*, belonging to the Norddeutsche Seekabelwerke Aktien-Gesellschaft, of Nordenham, Germany, passed Dover on the 10th inst. on her way home after an absence of as nearly as possible six months. She has during this time laid the section of cable between Menado, in the Celebes Islands, and Yap, in the Caroline

Islands, some 1,150 miles, and also that between Yap and Guam, 600 miles. In addition, she has taken numerous soundings, and laid a length of heavy cable off Shanghai as part of the Shanghai-Yap section, which will be taken in hand shortly. All these cables, of a total length of over 4,000 miles, are for the Deutsche-Niederlandischen Telegraphen Gesellschaft, of Cologne.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Trinidad-Demerara (No. 2)	July 1, 1905	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Paramaribo-Cayenne	May 25, 1905	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chifu	Mar. 9, 1904	
Jamaica-Colon	Jan. 5, 1905	
Bolama-Bissao	June 21, 1905	
St. Jacques-Haiphong	June 26, 1905	July 5th
Landlines.		
Puerto-Barrios	July 28, 1902	
Kertch-Soutehoum	Sept. 27, 1904	
Alaska landlines	July 10, 1905	

Telegraphs and Telephones of Belgium during 1903.—Since June 1st, 1903, at the instance of the Department of the Interior and Agriculture, telegraphic weather bulletins for the following day have been distributed, issued by the Royal Meteorological Observatory at Uccle, and this service has been instituted entirely in the interests of agriculture. The bulletins are displayed at the telegraph offices of districts which have subscribed therefor for a minimum period of one month; and in the event of any district so failing to subscribe, any individual may become a subscriber. The largest number of subscribers were obtained during the month of August, when there were 21. Traffic between Belgium and foreign countries increased during the year by 1·4 per cent., but transit traffic decreased by 7·01 per cent., chiefly due to Anglo-German traffic "*via* Belgium" by reason of interruptions and the more rapid working on the direct wires connecting those countries.

Germany again leads in the number of telegrams exchanged with Belgium, with 701,848 as against 686,434 for France and 502,282 for Great Britain. But it is interesting to note that while the profit to Belgium on the German telegrams amounted to 503,980 fr. (£20,159) that on French messages was 484,212 fr. (£19,368) and Great Britain gave them 533,249 fr. (£21,329). The system of lines, cables, &c., increased during the year by 93 kilometres to 6,608 kilometres of line, or 135,467 kilometres of wire. There are also 3,050 metres of pneumatic tubes connecting the central station to each office on the Exchange.

The receipts for the year amounted to 10,401,599 fr., or £416,064, *i.e.*, 4,896,878 fr., or £195,875, on account of the telegraphs, and 5,504,721 fr., or £220,181, on account of the telephone service. Receipts for registration of abbreviated addresses amounted to £2,262. Expenses for the telegraph and telephone services amounted to 7,410,902 fr. (£296,436), leaving a surplus for the year of £119,628. Up to December 31st, 1903, the total capital expenditure was £1,821,482.—*Journal Télégraphique.*

Wireless Telegraphic Communication with Iceland.—The *Standard* states that according to Reuter advices from Reykjavik, dated July 4th, agents of Messrs. Siemens & Halske, Berlin, and of the Marconi Co., are both in communication with the Althing, and have proposed to install wireless telegraphy between Iceland and the Continent and between the four commercial towns of the island. The Siemens offer agrees to provide the installation for about £36,666, and offers to deposit a guarantee for efficient working. The cost of maintenance per annum is estimated at about £2,777.

The first Marconi wireless messages, containing the latest items of European news, arrived on June 28th, and the same evening the newspapers published special editions containing these dispatches, which initiated a new era in Icelandic journalism. The transmission of the messages was entirely successful in spite of the distance—960 miles.

Wireless Telegraphy in the Navy.—Sir Thomas Dewar asked the Secretary to the Admiralty to what extent the system of wireless telegraphy has now been applied to His Majesty's Fleet, and Mr. Pretyman, in replying in the Parliamentary papers for Wednesday, stated that the system had been generally applied to all battleships and cruisers and certain special craft.

CONTRACTS OPEN AND CLOSED.

OPEN.

Bath.—July 17th. Supply and erection of a storage battery. See "Official Notices" July 7th.

Beckenham.—July 22nd. Water-tube boilers and steam alternator for the U.D.C. See "Official Notices" to-day.

Belgium.—The State Railway Authorities at La Bourse, Brussels, are inviting tenders until the 19th inst. for the supply of 35 220-volt motors, three 550-volt motors, 10 440-volt motors; also for one 110-volt dynamo, and one 600-volt dynamo.

Caerphilly.—July 24th. Cables, kiosks, transformers, switchgear, lamp pillars for the U.D.C. See "Official Notices" June 30th.

Dublin.—July 21st. Machinery oils for the Corporation. See "Official Notices" July 7th.

Dublin.—July 25th. Tenders to the Corporation for three electric locomotives, tramways, mains, trolley wires, capstans, &c. See "Official Notices" July 7th.

Dudley.—July 29th. Supply of oils to the Corporation. See "Official Notices" to-day.

Ebbw Vale.—August 5th. Cables, overhead lines, street lamps and fittings, and meters, for the U.D.C. See "Official Notices" to-day.

Germany.—Tenders are about to be invited for the establishment of a central electric lighting station in the town of Feldkirch at an estimated cost of £65,000.

Hamilton.—July 15th. The Corporation invites offers for the construction and working of electric tramways. See "Official Notices" June 23rd.

Kilkenny.—The Corporation having obtained a prov. order, will, if necessary, lease the same for a term of years, and will pay £400 a year (or more) to any firm or company providing the light and supplying all plant, &c. Ample water power available within and outside the City. For details apply R. J. Gore, C.E., Town Hall, Kilkenny.

Loughborough.—July 18th. Stores, &c., for the electricity department. See "Official Notices" June 30th.

Metropolitan Asylums Board.—Tenders are to be invited from eight selected firms for the installation of electric light, telephones, fire alarms, &c., at the South Eastern Hospital.

Mussoorie (India).—October 23rd. Supply and erection of steel power pipes, water motors, alternators with exciters, switchboards complete, transformers, induction motors, pumps, workshop machines; also bare copper overhead mains, insulators, and lightning arresters, arc and incandescent lamps, telephone equipment, workshop tools and general stores. See "Official Notices" to-day.

Neath.—July 17th. Mains, sub-stations, switchboards, feeder and switch pillars, excavations, &c., for the U.D.C. electric lighting scheme. See "Official Notices" June 30th.

Olympia Exhibition. 1905.—July 18th. Tenders are invited by the Committee for the loan or hire of a 300-kw. D.C. set. See our Advertisement pages to-day.

Roumania.—The Municipal Authorities of Turn-Severin are about to invite tenders for the concession for the electric lighting of the town.

Sheffield.—Sand drier for the Corporation's Tinsley Car Depôt. See "Official Notices" to-day.

Shoreditch.—July 18th. Two 1,500-kw. steam turbo-generators, condensers, pumps, piping, &c. See "Official Notices" June 23rd.

War Office.—September 1st. Tenders invited for the purchase of surplus boilers, dynamos, &c., at Bermuda, Barbados, St. Helena and Woolwich. See "Official Notices" July 7th.

Weymouth and Melcombe Regis.—July 14th. Stores and coal for the electricity department. See two "Official Notices" June 23rd.

Worthing.—July 24th. Dry-back boiler with fittings, piping, cables, stoneware conduits for the Corporation. See "Official Notices" to-day.

CLOSED.

Battersea.—The B.C. has accepted the tender, at £770, of Messrs. J. Cochrane & Sons for work in connection with the condensing plant at the central station.

Birmingham University.—A motor-generator set for educational purposes has been ordered from the Brush Co.

Bombay.—The extension power house and sub-station plant, consisting of two 500-kw. steam turbo-electric generators, two 500-kw. motor-generators, two 50-kw. motor-generators, with boilers, condensers, switchboard and accessories, has been placed with the Brush Electrical Engineering Co.

Cheltenham.—The T.C. has accepted the tender of Messrs. Johnson & Phillips, of Old Charlton, for the supply of arc lamp carbons, at £1 10s. 6d. per 1,000.

Aston Manor.—The following tenders have been received for contract No. 7, in connection with the overhead electrical equipment of the Corporation tramways (Robert Green, A.M.I.C.E., engineer):—

Brush Electrical Engineering Co. (including paper lead-sheathed cable)	£4,338 5 4
Robert W. Blackwell & Co. (including paper lead-sheathed cable)	4,436 5 3
Johnson & Phillips (including paper lead-sheathed cable)	4,567 11 1
Brush Electrical Engineering Co. (including vulcanised bitumen cable) (accepted)	4,305 15 7
British Insulated & Helsby Cables (including paper lead-sheathed cable)	4,627 2 6
British Electric Equipment Co. (11, Queen Victoria Street, London, E.C.)	4,651 17 6
Robert W. Blackwell & Co. (including vulcanised bitumen cable)	4,751 4 1
British Insulated & Helsby Cables (including vulcanised bitumen cable)	4,902 6 6

Darlington.—The T.C. has accepted the tender of the Tudor Accumulator Co., Ltd., for the supply and erection of a storage battery, and for maintenance for 10 years.

Fulham.—The B.C. has received the following tenders for coal-conveying apparatus in connection with the extension scheme:—Messrs. Mather & Platt, conveyor only, £630; Wantage Engineering Co., conveyor only, £725; Graham, Morton & Co., conveyor only, £958; ditto. £1,186; Heenan & Froude, Ltd., £1,383; Temperley Transporter Co., Ltd., £1,700; ditto, £2,165; ditto., £1,700; Transporter Co., Ltd., £1,732; ditto, £1,853; R. Dempster & Sons, Ltd., £1,834; E. Bennis & Co., Ltd., £1,982; ditto., £1,749; New Conveyor Co., Ltd., £2,140; Somervaile & Co., £2,210; Barry & Co., Ltd., £2,060; Fulham Steel Works, £2,975; ditto, (accepted) £1,935.

Gillingham (Kent).—The T.C. has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for the supply of a boiler and piping to the electricity works, at £1,010.

Hackney.—The B.C. has accepted the tender of Messrs. Le Grand & Sutcliffe for an artesian well and pumping plant, at £1,370 16s.

Salford.—The T.C. on July 5th accepted the following tenders for supplies to the electricity and tramway departments:—Electrical Co., Ltd., heating apparatus, &c.; Messrs. L. Andrew and Co., Manchester, boiler gauge cones, sight feed rings, fuse wire, foil, rubber gloves, bells, lamps, &c.; Messrs. Johnson & Phillips, fire resisting rubber-covered cables; Messrs. R. W. Blackwell and Co. and the Malleable Steel Castings Co., mechanical car accessories; Mr. S. H. Heywood, Manchester, trolley heads and wheels; Liverpool Electric Cable Co., cables; B.I. & H. Cables, Ltd., rubber solution and strip, mica, fuse boxes, &c.

Swindon.—The T.C. has accepted the tender of Messrs. Crompton & Co., of Chelmsford, for the supply of arc lamps for hiring out.

Walsall.—The T.C. has accepted the tender, amounting to £721, from the G.E. Co. for supplying and erecting electric fittings at the Council House.

FORTHCOMING EVENTS.

Saturday, July 15th.—At 7.30 p.m. Birmingham and District Electric Club. Mr. W. S. Yarrow on "High Tension Switchgear and Apparatus."

Wednesday, July 19th.—North of England Institute of Mining and Mechanical Engineers. Excursion to inspect the Barton and Forcett Mountain Limestone Quarries. Assemble at Darlington Railway Station at 1 p.m.

London Congress of the Royal Institute of Public Health opens.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued for next week:—

Thursday, July 20th.—Recruits and non-efficients for Felixstowe Camp, parade at Liverpool Street Station (G.E.R.) at 11.15 a.m. Those for Isle of Wight Camp, at Waterloo Station at 12 noon.

Saturday, July 22nd.—Efficients for Felixstowe Camp, parade at Liverpool Street Station (G.E.R.) at 11.15 a.m. Those for Isle of Wight Camp, at Waterloo Station at 12 noon.

J. J. F. O'Shaughnessy, Captain.
For O.C.E.E.R.E. (V.).

NOTES.

National Telephone Co.'s Staff Dinner.—Owing to an unfortunate mishap at the moment of going to press, we are unavoidably compelled to hold over our report of this dinner until next week.

Hydraulic Main Burst.—Considerable excitement was caused in the West End on Tuesday by the bursting of a hydraulic water main at the corner of Lower Regent Street and Piccadilly Circus. It was through this main that the London Hydraulic Power Co. served a large number of its subscribers in the district, and as a result of the accident practically all the lifts in that section became inoperative. At Daly's Theatre the performance had to be closed; the fireproof curtain had been lowered, and it was found impossible to raise it. Moral: Use electric lifts.

The Brush and B.E.T. Sports.—On Saturday last we were privileged spectators at the second annual athletic festival organised by the staff of the Brush Electrical Engineering Co., and held on the football field adjoining the works. The events are, of course, equally open to representatives of the B.E.T. companies, and a contingent some 90 strong journeyed down to Loughborough on the Saturday morning, from St. Pancras.

The first event, not entered on the Sports programme, was a luncheon; this naturally attracted a substantial entry, and whether due to the shortness of the course, or the excellent training of the competitors, resulted in a close finish.

The interval which followed was profitably employed by ourselves and others in a tour of the works, which are just now very fully employed. In the car-building shops were to be seen excellently finished specimens of the genus electric tramcar for the Corporations of Belfast, Leith, Derby, &c., also many skeletons of its would-be rival, the mobus, not, of course, that the former species are in any way carnivorous.

In the engineering shops, one might easily, without going out of one's way, fall over turbine parts, so prominent are the latter class of prime mover among the firm's productions at the present time. We were shown turbo-generators either completed, or in course of construction for installation at, among other places, Middlesbrough, Bombay, Willesden, &c., the plant for the latter place consisting of a 1,000-kw. two-phase set. There were also on view Brush high-speed engines, generators and motors of various sizes.

But to return to the sports, which had started, or, perhaps, we should say had been resumed in our absence; some 15 events were to be decided, which included flat races over distances up to 880 yards, and for which the entrants varied in age from bare 'teens to the respectable 78¼ years of Mr. George Offer, whose energetic display in the veterans' race was vigorously applauded. Relay races, scratch football races, a tug of war, high and long jumps, push ball, and the exciting, albeit cooling pastime, of tilting the bucket, helped to pass a very pleasant afternoon. The programme was carried through without a hitch, and its punctual performance reflects great credit on the organising secretaries, Messrs. J. S. Turner and W. S. Wreathall, and others concerned.

Through it all, the band of the local Rifle Volunteers, under Sergt. H. G. Lovett, provided suitable musical entertainment, and with a self-denial as regards intervals, which, in such weather, deserves placing on record.

Shortly after 5 p.m. the prizes were distributed by Lady Vaux of Harrowden, and although we did not stay later, we understand that dancing and cake walking completed a very enjoyable day.

Locally, the event evidently excites considerable enthusiasm, and the very numerous attendance would lead us to surmise that the sports are successful in more ways than one.

Appointments Vacant.—An assistant lecturer in electrical engineering, at £160 per annum, at the Municipal Technical Institute, Belfast; an assistant electrical engineer is required by the Acton U.D.C. at £130 per annum; Depôt and rolling stock superintendent for Brighton Corporation Tramways, at £3 per week. See "Official Notices" to-day.

Institution Notes.—The Institution of Civil Engineers.—The annual "Squash" of the Civil Engineers and their wives, daughters and lady friends was held at the Institution in Great George Street on Wednesday, July 5th, from 9 to 12 midnight, the guests being received by the President and Lady Molesworth. After the reception the guests had the choice of a large number of entertainments, both intellectual and frivolous, from which they could derive amusement, there being an excellent musical programme, an interesting collection of paintings (mostly portraits), and an exhibition by Sir William Abney, K.C.B., F.R.S., of landscape views illustrating developments in colour photography; as regards this latter, however, the room was very crowded and hot, and the lecturer often inaudible owing to the rustling and moving about, hence much of what was doubtless valuable was lost by those anxious to learn. On the top floor was an electrophone in connection with the theatres, and this was largely patronised by the visitors, a constant stream of people continuously flowing in and out of the little room. The Misses Eugénie and Virginia Sassard sang, and the string band of the Royal Artillery gave a large and varied selection of music.

Municipal Tramways Association.—On Thursday, July 6th, through the kind invitation of Mr. Councillor A. H. Bull, J.P., Chairman of the Reading Corporation Tramways Committee, the Members of the Municipal Tramways Association attending the Conference in London journeyed to Reading by special train. The members, who were accompanied by a large number of ladies, were received at the station by Mr. Walter Binns, general manager and engineer of the Reading Corporation Tramways. The Town Hall was tastefully decorated for the occasion, and at noon the party were received by the Mayor of Reading (Martin J. Sutton, Esq., J.P.), Mr. Councillor A. H. Bull, J.P., and Mrs. Bull, in the Council Chamber. Subsequently the party adjourned to the large Town Hall, where a first-class luncheon was provided through the kindness of Mr. Bull. An interesting souvenir of the occasion was prepared by Mr. Binns. A short toast list was gone through, and the party then walked through the Forbury Gardens, where the flower beds were most beautifully laid out, to the ruins of the old Abbey, where the whole of the party were photographed. The steam launch *England*, the largest launch on the upper Thames, was requisitioned by Mr. Bull, and the party embarked

at Caversham Lock and proceeded down the Thames to Henley, tea being served on board during the trip. On reaching Marsh Lock, Mr. C. R. Bellamy, of Liverpool, expressed to Mr. Walter Binns, on behalf of the Association, their best thanks and appreciation of the admirable arrangements which had been made for their comfort and pleasure. Mr. Binns briefly acknowledged the vote of thanks, and referred to the great kindness of Mr. Councillor Bull, who had spared no pains or expense to make their visit a happy and memorable one. Arriving at Henley, through the kindness of the Mayor of Reading, members were permitted to go on to the lawns at Phyllis Court, from which a splendid view could be had of the Regatta and fireworks, while concerts were given during the evening in the grounds. The members returned to London later in the evening, and all who took part in the day's proceedings will retain a pleasant recollection of the occasion for many years to come.]

Royal Institute of Public Health.—The London Congress of this Institute will be opened on Wednesday next, and will continue until 25th inst. The congress will be received by a reception committee of Metropolitan mayors, headed by the Lord Mayor, and will afterwards be conducted in sections at King's College and the Polytechnic, Regent's Street, a large number of papers being set down for discussion. While none of the papers appears to be of direct technical interest to electrical engineers, the subject, as a whole, is of interest to everybody, and we therefore have pleasure in drawing attention to the congress. Further particulars may be obtained from the secretary, The Royal Institute of Public Health, 37, Russell Square, W.C.

Perpetual Motion.—The day of the perpetual-motion man is not yet over. He has been ousted from many of the favourite mechanical regions in which he used to earn a reputation, but he finds a new field in electrical mysteries. One would have thought that the public would have been satisfied with the disappointments attaching to some of the fanciful schemes of 12 or 15 years ago, but there is evidence of survival still, and survival means that members of the public are being smitten. A letter recently received by one who is addressed in his capacity as an electrician, asks him to subscribe for shares in a company which is to "abolish generating stations, live rails, live wires, &c." Such a degree of success has already attended the preliminary work, that the first 500 shares sold at £1 are at a high premium; others have been sold at £25 each. The method is to use a dynamo which will run electrically instead of mechanically—a self-generating dynamo without steam or water power. The secret lies in the fact that "one of the currents (the induced) in the production of electricity, which has hitherto been lost (all attempts to use it having been baffled), can be harnessed, controlled, and used." This gives the inventor so much power, that "he can do without any mechanical power at all."

The recipient of the letter is informed that he can secure a few £1 shares (not more than 15) at £5 per share. The risk is a "minimum;" "the shares would necessarily become of incalculable value." The works of the perpetual-motion worker are over all this. The sanguine anticipation of success is not more striking than the implication of ignorance of the whole subject. Yet it is to be feared that money was forthcoming for this venture. Certainly the writer of this letter could not maintain the position indicated in his address, unless he "induced" a current of ready cash to flow into his coffers.

Corliss Valves.—A trade journal referring to some recently published tests of an engine in Belfast made by Messrs. Cole, Marchent & Morley, refers to them as proving the revivification of the Corliss engine. Now we believe that those particular engines have valves of the so-called drop piston type, and not Corliss valves. The engine worked with superheated steam, and the temperature is said to have been 700° F. at the stop valve. Hence the song of praise about the Corliss valve. The Corliss valve is not suitable for superheated steam beyond about 500° F. So at least one would judge by the attitude of Corliss engine makers, who appear to be afraid of superheated steam. Nor can we well wonder at it. The form and method of working the Corliss valve do not commend themselves in this direction. As a matter of fact, the Corliss valve is by no means the excellent thing it has been represented to be. Placed at the ends of a horizontal cylinder, the Corliss valve certainly did give excellent drainage, and the economy due to this was credited to the sharp cut-off. But when the Corliss valve was put into the cylinder ends, when it was put upon the top cover of a vertical cylinder, its advantage of location was destroyed, for no longer did it give a drainage better than other valves. The Corliss valve was an American importation, and it has still a considerable vogue in America as well as in this country, but it is not, nor ever has been, a valve to be used with superheated steam of high temperature. The drop piston valve is more suitable because the valve is kept away from flowing steam. The double-beat valve used by Continental engineers is more exposed than the drop piston, but it has no sliding contact. It merely shuts down on a seating, and is claimed to remain tight for a long time. The superiority of the mere disk valve over flat slides or Corliss valves ought to be considered proved by the fact that such valves are exclusively employed in gas engines, where they are exposed to temperatures much higher than those occurring in the steam engine. The Corliss valve has had its day, and no power station is going to secure the best results until it accepts superheating as a means towards the abolition of those losses which are due to imperfect vaporisation of water.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*]

Central Station Engineers.—The employés of the Ilford Electricity Works held their fourth annual outing on Saturday last, when about 30 journeyed to Clacton-on-Sea, leaving Ilford a few minutes before 8 a.m. They were favoured with one of the most beautiful days that our English climate can give; consequently, swimming, boating and driving were freely enjoyed. At 12 o'clock dinner was partaken of at Day's Restaurant, being presided over by the mains superintendent, Mr. J. E. Allen, supported by the station superintendent, Mr. J. R. Myers, and the chief clerk, Mr. H. King. After dinner the health of the chief electrical engineer, Mr. A. H. Shaw, was proposed by Mr. Allen. Mr. Myers supported the toast, which was drunk with musical honours, and a telegram was dispatched to cheer Mr. Shaw in his absence. Mr. King proposed thanks to Mr. Robt. Stroud (late chairman of the Council) for his good wishes to the staff, to Mr. Edgar Porter for his presence with the party, and especially to Mr. J. Busby (works foreman) for acting as secretary of the outing; and he asked the chairman to present Mr. Busby with a pipe and case. Mr. Robins (mains foreman) then proposed the chairman's and Mr. Myers' health, which was drunk with musical honours. The party returned by the 7.10 p.m. train from Clacton, and arrived home about 9 p.m., after a most enjoyable outing.

On Saturday, 1st inst., the third annual outing of the staff of the Stepney Borough Council's electrical department took place at Hastings. Leaving Cannon Street in a downpour of rain, the party was agreeably surprised to find fine weather prevailing at this renowned watering place, which was reached about 11 o'clock. An excellent dinner was thoroughly enjoyed at the Priory *Café* at noon. In the unavoidable absence of Mr. W. C. P. Tapper (engineer and manager), Mr. W. Young was elected chairman, with Mr. T. G. Bransford in the vice-chair. Thanks were voted to the hon. secretary, Mr. T. J. Archer, and the hon. treasurer, Mr. R. Baker, to whose efforts the success of the outing was largely due. In the afternoon some of the party strolled along the Cliffs and visited the Castle Ruins, Caves, &c., while others indulged in a "dip in the briny." Leaving Hastings at 7.30 p.m., London was reached at 9.32 after a very enjoyable day. The committee is again indebted to Mr. Alderman R.A. Kearsey (chairman of the Electrical Committee), Mr. Arthur Wright (consulting engineer), and Mr. W. C. P. Tapper, for financial support in connection with the outing.

Stockton-on-Tees T.C. has increased the salary of Mr. J. J. Smith, electrical engineer, by £25 per annum.

The Aston T.C. has appointed Mr. Robert Foster as resident electrical engineer, at a salary of £300.

Leek U.D.C. has increased the salary of the electrical engineer from £150 to £175 per annum, and that of the assistant electrical engineer, from £91 to £104.

Dover T.C. has increased the salary of Mr. L. W. Woodman, the electrical engineer, from £350 to £425 per annum, on condition that no further increment is asked for, for two years.

The Tunbridge Wells T.C. on July 5th discussed a recommendation to increase the salary of Mr. D. Smith, assistant electrical engineer, from £175 to £200 per annum, but the matter was referred back. One member who opposed, asserted that "engineers were very cheap now, and were simply tumbling over one another."

In consequence of recent promotions in the Battersea electricity department, the committee has recommended that Mr. A. Whitie be appointed station superintendent at £140 per annum.

On Monday last week, the staff and employés of the Paisley electricity department, accompanied by the convener, Bailie Fisher, and the chief engineer, Mr. Parkinson, and a few friends, held their annual outing. Leaving Paisley for Gourock at 8.57 a.m., and taking the *Lord of the Isles* across to Dunoon, the party left Dunoon in coaches for Inverchapel, where the *Fairy Queen* awaited them to sail up Loch Eck, and then coaches were again taken to Strachur. A halt was made at Strachur, dinner being served at Creggan's Hotel, where full justice was done to an excellent meal, Bailie Fisher presiding. Atfer the usual loyal toast had been given, the party left Strachur by the *Lord of the Isles*, arriving at Rothesay at 5.30 p.m., where tea was taken at the Royal Hotel. Having an hour or so to spare before returning home, the party dispersed until 7.50 p.m., at which time they left for Paisley, arriving home at 9.45 p.m. Great admiration was expressed for the lovely sceney passed through.

The marriage took place on July 3rd, at Birstall Parish Church, of Mr. G. H. Carter, resident and consulting engineer to the Heckmondwike District Council, to Miss E. K. (Katie) Fillingham, eldest daughter of W. E. Fillingham, Esq., Bramley, Yorks. The ceremony was conducted by the vicar, the Rev. Hervey.

Tramway Officials.—The Tramway Committee of Ashton-under-Lyne T.C. on July 5th appointed Mr. Joseph Dugdale as tramway manager. Mr. Dugdale has for the past year been manager and engineer of the Oxford tramways, and previously was traffic superintendent at Sheffield.

Eccles T.C. has granted an honorarium of £250 to the surveyor (Mr. Picton) for extra services rendered in connection with the construction of the electric tramways.

General.—Mr. Sidney C. Sheppard wishes to thank the various firms who have sent him catalogues and information about their electrical plant. As he has had to leave for Bolivia a good deal earlier than expected, and is unable to reply individually

to the various letters in connection with the above, he takes this opportunity of thanking each, for the information received.

City of London.—The salary of Mr. Harold Leslie Dixon, Inspector of Overhead Wires, has been increased to £220 per annum, with annual increments of £10 per annum for three years up to a maximum of £250.

Mr. R. Heywood Claxton, on retiring from the position of superintendent of the north-western province of the National Telephone Co., after 26 years' service, has been presented by the company's staff in the area, with an ornamental Shannon desk, four framed water colours of Lakeland scenery, and a copy of "Beautiful Wales" (Robert Fowler).

Mr. R. Seymour Benson, who has resigned the position of managing director of the firm of Messrs. Ashmore, Benson, Pease and Co., Ltd., of Stockton-on-Tees, has been presented by the officials with a massive silver tray, and by the workmen with a silver fruit dish.

Obituary.—Mr. Henry Clifford, of Blackheath, formerly engineer-in-chief of the Telegraph Construction and Maintenance Co.'s Works, who died last May, left estate valued at £89,210 gross, with net personalty amounting to £87,718 2s. 9d.

Mr. J. B. Verity, late chairman of Messrs. Verity's, Ltd., director of the Metropolitan Electric Supply Co., Ltd., and connected with the Alliance Electrical Co., Ltd., who died at Wallingford on April 6th, last, left estate of the gross value of £45,210, of which the net personalty has been sworn at £39,568.

We regret to announce that Mr. William Bruce Dick, founder of the electrical engineering firm of Messrs. Dick, Kerr & Co., died suddenly on Tuesday, at the age of 75, at Carrick Grange, Sevenoaks.

We have also to record with regret the death, on July 5th, after a short illness, of Mr. John Thomas Connolly, one of the directors and founders of the firm of Connolly Bros., Ltd.

NEW COMPANIES REGISTERED.

Johnson Secret Wireless Telegraph and Telephone Testing Syndicate, Ltd. (85,182).—This company was registered on July 7th, with a capital of £15,000 in £1 shares, to acquire the interests and patents of the vendors in the "Johnson System of Secret Wireless Telegraphy and Telephony," together with all subsequent improvements thereon by the inventor, to test and develop the said system, to promote an exploitation company to be called the Johnson Secret Wireless Telegraph and Telephone Co., Ltd., the nominal capital of which is intended to be £250,000, to adopt agreements (1) between the Invention Proprietary Syndicate, Ltd., and Dr. E. J. Richardson of the first part, A. T. M. Johnson of the second part, W. F. C. Michaelis of the third part, and this syndicate of the fourth part, and (2) with M. Hohner, to acquire, construct and deal with land, aerial, marine and submarine telegraphs and telephones, &c. The first subscribers (each with one share) are: A. T. M. Johnson, 77, Shepherd's Bush Road, W., inventor and engineer; W. F. C. Michaelis, 7, Lancaster Road, Tulse Hill, S.W., manager in England to M. Hohner; E. J. Richardson, 41, Brook Street, Grosvenor Square, W., gentleman; A. G. Hellyar, 196, King Street, Hammersmith, W., electrical engineer; T. Barnett, 9, Great College Street, Camden Town, clerk; A. Angold, 12A, Green Lanes, Newington Green, N., auctioneer; and H. Blamey, 36, Westwick Gardens, West Kensington, musician. Minimum cash subscription, £2,500. The number of directors is not to be less than three nor more than seven; the first are A. T. M. Johnson, A.M.M.C.I.E., and W. F. C. Michaelis (joint managing directors), and E. J. Richardson, with power to add four others. Remuneration of joint managing directors, £250 each per annum; of chairman, £75 per annum; of ordinary directors, £52 each per annum. No dividends will be paid on the capital of this syndicate, but any sums received will be employed in furthering the tests and facilitating the formation of the Exploitation Co., after which any surplus funds will be distributed in the usual manner. The vendors (the Invention Proprietary Syndicate, Ltd., and Dr. E. J. Richardson) have fixed the price of the invention at £10,000, payable wholly in shares, plus the amount of certain expenses undertaken by this syndicate, estimated not to exceed £250. It is proposed that on the formation of the Exploitation Co. this syndicate shall receive not less than £150,000 (payable half in cash and half in shares) for the patents and their interest therein, or a larger price if the nominal capital of the Exploitation Co. be more than £250,000. Registered office, 40, King Street, Cheapside, E.C.

Musselburgh and District Electric Light and Traction Co., Ltd. (85,169).—This company was registered on July 6th, with a capital of £120,000 in £1 shares (60,000 6 per cent. cumulative preference), to carry on the business of railway and tramway proprietors, suppliers of electric light and power, electrical engineers and the like, to adopt an agreement with the National Electric Construction Co., Ltd., to acquire (under the provisions of the Tramways Act, 1870) the undertaking authorised by the Portbello and Musselburgh Tramways Orders, 1900 and 1903, as amended by any subsequent orders, to take a transfer of the undertaking authorised by the Musselburg Electric Lighting Order, 1904, &c. The first subscribers (each with one share) are:—W. B. Cownie, 22, King's Avenue, Muswell Hill, N., accountant; J. T. Jervis, Queen Anne's Chambers, S.W., M.I.C.E.; B. Bernheim, 41, Lansdowne Road, W., gentleman; R. Watson, Queen Anne's Chambers, S.W., accountant; C. R. Hewson, Queen Anne's Chambers, S.W., cashier; E. A. Mitchell, Carshalton, electrical engineer; and F. E. Stanley, Queen Anne's Chambers, S.W., electrical engineer. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are W. H. Fowler, L. B. Schlesinger, J. T. Jervis, B. Bernheim and W. B. Cownie; qualification, £200; remuneration, £50 each per annum (charge £50 extra), and 10 per cent. of the surplus profits available for distribution after 5 per cent. has been paid on the ordinary shares, divisible. Registered office, Queen Anne's Chambers, Westminster, S.W.

Electric Accumulator Co., Ltd. (85,174).—This company was registered on July 6th, with a capital of £60,000 in £1 shares, to acquire from E. L. Opperman, of 21, Ashworth Mansions, Elgin Avenue, W., the benefit of certain existing inventions in relation to the manufacture of plates for secondary batteries or accumulators, to adopt an agreement between the said vendor of the one part and W. J. Webb (for the company) of the other part, and to carry on the business of makers of electrical apparatus, contractors, importers, exporters, merchants, electricians, engineers, producers of and dealers in electricity, &c. The first subscribers (each with one share) are:—H. C. Walrond, Charterhouse, London, shipowner; E. L. Opperman, 21, Ashworth Mansions, W., electrical engineer; W. J. Webb, 18, Leadenhall Street, E.C., secretary; F. A. Macrae, Belmont, Bowes Park, N., director; J. Morrish, 18, Leadenhall Street, E.C., manager; R. Cans, 42, Rosenthal Road, Catford, accountant; and J. McCanna, 9, Upper Chadwell Street, E.C., managing clerk. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £100; remuneration, £100 each per annum (chairman £50 extra) and 10 per cent. of any surplus profits remaining after payment of a dividend of 10 per cent. on the ordinary shares, divisible. Registered office, 18, Leadenhall Street, E.C.

A. J. Harris & Co., Ltd. (85,118).—This company was registered on July 3rd, with a capital of £2,000 in £1 shares, to acquire the business of an electrical engineer carried on at Borough Mills, Bradford, Yorks., by A. J. Harris as "A. J. Harris & Co.," to adopt an agreement with the said vendor, and to carry on the business of electrical and mechanical engineers, machinists, smiths, fitters, founders, wire drawers, tube makers, metallurgists, galvanisers, japanners, annealers, enamellers, electricians, &c. The first subscribers (each with one share) are:—A. J. Harris, 7, Elizabeth Street, Bradford, electrical engineer; H. Myers, 8, Wellands Terrace, Bradford, electrical engineer; L. Longthorpe, 42, Bridgewater Road, Bradford, merchant; J. W. Newall, 40, Bridgewater Road, Bradford, tea merchant; F. J. Sampson, Glenalmond, Sydenham, engineer; W. Harrison, 18, Ellercroft Terrace, Bradford, incorporated accountant; and J. J. Oates, 6, Rand Place, Bradford, clerk. No initial public issue. The first directors are not named; qualification, £20. Registered office, Borough Mills, Manchester Road, Bradford.

Wright, Methuen & Co., Ltd. (85,173).—This company was registered on July 6th, with a capital of £2,000 in £1 shares, to take over the business of electrical engineers, electricians, contractors and factors, carried on by J. Lockwood at 34, Pall Mall, Manchester, as "Wright, Methuen & Co.," and to adopt an agreement with the said vendor. The first subscribers (each with one share) are:—J. Lockwood, Waverley, Stretford, electrical engineer; J. Lawrence, 10, Curzon Avenue, Victoria Park, Manchester, electrical engineer; Mrs. E. Lockwood, 81, Cromwell Road, Stretford; J. W. B. Lockwood, 81, Cromwell Street, Stretford, engineer; Miss E. L. Lockwood, 81, Cromwell Street, Stretford; Mrs. N. Lockwood, Waverley, Stretford; Mrs. E. Lawrence, 10, Curzon Avenue, Victoria Park, Manchester; and Miss E. M. Lawrence, 10, Curzon Avenue, Victoria Park, Manchester. No initial public issue. J. Lockwood (chairman) and J. Lawrence are the first governing directors (both permanent, subject to holding 300 shares). Remuneration of J. Lockwood £200 per annum; of J. Lawrence, £150 per annum. Registered office, 34, Pall Mall, Manchester.

Pianophone Syndicate, Ltd. (85,154).—This company was registered on July 5th, with a capital of £25,000 in £1 shares, to adopt an agreement with Howard Bell & Co., Ltd., for the acquisition of the exclusive licence to manufacture, use and sell the electric pianophone and coinophone outside the U.S.A., and to carry on the business of musical instrument and apparatus makers, dealers and agents, engineers, financiers, bankers, underwriters, concessionnaires, &c. The first subscribers (each with one share) are:—A. Frith, 37, Queen's Gate Gardens, South Kensington, S.W., solicitor; R. T. Harper, 87, Ebury Street, S.W., chartered accountant; M. P. Gossett, 21, Great Winchester Street, E.C., mining engineer; D. S. S. Stuart, Roselea, Muswell Hill, N., mining engineer; R. C. Vidler, 31, South Street, Thurloe Square, S.W., mining engineer; H. B. Horn, 40A, Hosack Road, Balham, S.W., secretary; and E. W. Turley, 1, Northumberland Street, Baker Street, W., accountant. Minimum cash subscription, 10 per cent. of the shares offered to the public. The number of directors is not to be less than two nor more than nine; the subscribers are to appoint the first; qualification, 100 shares; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Tramways and General Construction Co., Ltd. (78,034).—A memorandum of satisfaction in full of a charge dated April 20th, 1904, securing £120,000, has been filed.

London United Tramways (1901), Ltd. (71,844).—An acknowledgement of indebtedness under seal, dated June 13th, 1905, creating £258,000 further debenture stock (making, with £1,031,000 already created, a total of £1,289,000, and being supplemental to a trust deed, dated February 26th, 1902, and an acknowledgement of indebtedness dated July 28th, 1903, securing the said £1,031,000 debenture stock), has been registered. Property charged: Land and premises at Turnham Green, Acton, Richmond, Hanwell and Hounslow, and the company's undertaking and property, present and future, including uncalled capital. Trustees: Right Hon. Lord Revelstoke and Sir George White, Bart. A further acknowledgement of indebtedness under seal, bearing same date, creating £42,000 debenture stock, in addition to the above-mentioned £1,289,000 (making a total of £1,331,000, and being supplemental to the trust deed and acknowledgements covering the said £1,289,000 debenture stock), has also been registered. Property charged and trustees: As above.

Light Cure and Electro-Therapeutic Institute, Ltd., London (78,946).—Issue, on June 29th, of £50 debentures, part of series created December 15th, 1904, to secure £1,500, charged on the company's property, present and future, including uncalled capital. No trustees. Previouly issued of same series: £540.

London Electron Works Co., Ltd. (82,209).—£2,300 debentures, created June 19th, 1905, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees. Holder: E. de Back, Vienna.

African Direct Telegraph Co., Ltd. (21,895).—This company's annual return was filed on June 15th, when 23,600 shares had been taken up out of a nominal capital of £300,000 in 30,000 shares of £10 each. £236,000 has been received. Mortgages and charges: £57,800.

Heswall Electric Light Co., Ltd. (55,482).—This company's annual return was filed on June 27th, when 1,225 shares had been taken up and paid for in full out of a nominal capital of £1,500 in £1 shares. Mortgages and charges: Nil.

ELECTRICITY SUPPLY ACCOUNTS.

Hull Municipal Electricity Supply.

The satisfactory feature of the Hull Electricity Department was last year, as in 1904, the growing power load, the supply for which increased from 1,186,486 units in 1904, to 1,318,792 last year, or some 132,306 units, out of the total 195,624 extra units sold by the department during that period. During the year the working costs improved to the extent of .28d. per unit, and, probably due to more economical working rather than increased output, the revenue substantially benefitted.

On the year's working, after meeting financial obligations, a balance of over £6,000 was carried to reserve and depreciation,

this comparing with some £2,800 similarly dealt with in the previous year. The prices charged are:—Private lighting, 4½d. per unit flat rate, or 5d. and 2d. on the maximum demand system; power, 2d. to 1d. per unit on a sliding scale; public arcs, £22 per annum. The chief engineer is Mr. H. Bell.

General Statement.

For year ending March 31st—	1905.	1904.
Total capital expended	£302,933	£282,910
Number of units sold—		
Private lighting	1,827,870 }	2,971,428
Motors	1,318,792 }	
Public lighting	66,150	45,760
Total number of units sold ...	3,212,812	3,017,188
Equivalent No. of 8-c.p. lamps connected	240,512	217,916
h.p. of motors connected	2,670	2,280 h.p.
Number of public lamps	62	32
Maximum load in kw.	3,520	3,090
Revenue Account—		
Gross revenue	£39,867	£37,887
„ expenditure	£17,167	£19,660
„ profit	£22,700	£18,227
Average price obtained per unit—		
Lighting supply	4·06d. }	3·25d.
Motors	1·32d. }	
Public lighting	1·80d.	1·56d.

Revenue Account for Year, 1904-5.

Gross revenue	£39,867	=	2·98d. per unit.
Works and distribution costs (including public lighting) ...	£13,777	=	1·03d. „
Total working costs...	£17,167	=	1·28d. „

Profit Statement, 1904-5.

Interest on loans	£9,482
Sinking fund	6,985
Balance carried to reserve	4,981
To depreciation on meters	1,252
Gross profit	£22,700

CITY NOTES.

Edmundson's Electricity Corporation.

The eighth ordinary general meeting of this company was held at the Westminster Palace Hotel on Thursday last week, Mr. Francis E. Gripper, in the chair.

In moving the adoption of the report (Electrical Review, p. 28), the Chairman remarked that the year's work had, on the whole, been satisfactory. When he addressed the shareholders a year ago he explained that it was not the intention of the directors to seek for any further powers for new undertakings, as they had ample scope in the development of the undertakings in which they were already interested. During the year the electric lighting works at Newbury had been completed and opened, and the works at Inverness and Ramsgate had been so far completed that a supply had been commenced at Inverness in April last. They would be ready to give a supply at Ramsgate during next August. The works in connection with the Lancashire Electric Power Co. had also been so far completed that a commencement of supply would be possible at the end of this month. The progress of the various undertakings in which the company was interested was shown by the increase during the year of the lamps connected from 568,000 to 761,000. The result of the year's trading was a net profit of £38,618, which was about £1,000 less than last year. That was the first time the directors had had to note a decrease in their trading profits, and the explanation of such decrease was that a smaller amount of work had been carried out for their various subsidiary companies. That must naturally be the case as the growth of the capital expenditure of those companies decreased. The revenue which they had received as interest and dividends on their investments during the year had been £30,104 17s. 8d. That was about £11,000 more than the amount that was derived from that source during the previous year. The total profits, including a small amount for transfer fees, amounted to £68,882, as against £63,698 last year. That was an increase of about £5,000, and including the balance of £13,923 11s. 3d. brought forward from last year's account, the total amount to be dealt with was £82,746 4s. 6d. The directors recommended that £6,635 9s. 11d. be carried to the reserve fund, and that a final dividend at the rate of 9 per cent. be paid on the ordinary shares. They would carry over £15,000.

The report was adopted.

New General Traction Co.

The ninth annual general meeting of this company was held on Thursday last week at the offices of the company, Baron Emile B. d'Erlanger presiding.

In moving the adoption of the report, the Chairman said that during the past year it had been the policy of the board to reduce expenses as much as possible. General expenses, which were £3,272 in the previous year, had been reduced to £2,586. The company had received in the way of dividends from its sub-companies the sum of £9,878, to which sum should be added £2,211 paid to them after the end of March. The amount received from the sub-companies showed an increase over the year 1904 of £2,675, and of £3,724 over the year 1903. That was certainly progress, and he trusted with confident hope that considerable further improvement would be shown in the future. Dealing with the credit side of the balance-sheet, the chairman pointed out that the securities in hand amounted to £646,298, against £611,496 in 1904. To that they must add the sum of £9,843 for remittance to Philadelphia and also a sum of £5,000 expended in rolling stock for the American lines. The Philadelphia system was now completed, and the company had received the whole of the securities—£170,000 bonds and £139,000 shares. They would also be creditors for the sum of £5,000, having acted towards the subsidiary company in the capacity of a car trust. The reconstruction of the Coventry Tramways had now been completed, while in Norwich the company had had no capital outlay of any importance to meet, and the Norwich Co. was more or less in *statu quo*. The receipts from Philadelphia had shown a good expansion, having amounted to £7,632 up to June 18th of this year. The Coventry Tramways showed a decrease in the receipts, but it was due to disorganisation of the traffic by the reconstruction. The new lines were opened in March last.

The report was adopted, and the Hon. A. G. Brand, M.P., was re-elected on the board.

The British Continental Electricity Co.

The report of the directors, to be submitted to the ordinary general meeting at the company's offices on Friday, 28th inst., at 12 noon, states that during the year 71 new installations have been connected, while the number of lamps added during this period has been 2,413 equivalent 8-c.p. Notwithstanding this satisfactory development, however, the gross receipts from sale of energy have fallen, owing to the season having been a very unfavourable one. The all-day supply from the "Societá Negri" was initiated in December. After writing off £113 13s. 8d. as depreciation in respect of furniture, tools, meters, &c., £75, as usual, from preliminary expenses, and £100 as depreciation of plant, the balance standing to the credit of revenue account, including the sum brought over from last year, is £760 13s. 4d., which amount the directors recommend shall be appropriated to pay a dividend at the rate of 5½ per cent. per annum on the 5½ per cent. cumulative preference shares for the year ended April 30th, 1905, absorbing £550, and leaving a balance to be carried forward of £210 13s. 4d. The sum of £1,105 14s. has been spent on capital account during the year, chiefly to give effect to the agreement with the "Societá Negri," under the terms of which future capital expenditure will be reduced to a minimum. In accordance with the articles of association Mr. H. W. Buddicom retires from his directorship, and, being eligible, offers himself for re-election. The auditors, Messrs. Hercules Nicol and Barker, also retire, and, being eligible, offer themselves for re-election.

Marconi's Wireless Telegraph Co.

An extraordinary general meeting of the shareholders of this company was held on Tuesday at the offices, Finch Lane, Cornhill, Mr. Cuthbert Hall presiding. The Chairman proposed certain alterations in the articles of association that were needed to comply with the requirements of the Stock Exchange, in order to get an official quotation for the shares. The following resolution was also proposed, in order to raise additional capital to meet the expansion of the business, it being the intention of the directors to offer the new shares to the existing shareholders:—"That the capital of the company be increased to £500,000 by the creation of 200,000 further shares of £1 each."

Major Flood Page seconded the resolution, and it was carried.

National Telephone Co.

The report of the directors for the half-year ending June 30th, 1905, to be presented to the shareholders at the ordinary general meeting of the company to be held at Hamilton House on 20th inst., at 12 o'clock noon, states that the income accrued in respect of the business of the half-year amounts to £1,086,506 17s. 1d., as compared with £985,273 19s. 2d. for the corresponding period of 1904, being an increase of £101,232 17s. 11d. The working expenses for the half-year amount to £630,250 11s. 4d., as compared with £563,060 1s. 10d. for the corresponding period of 1904, being an increase of £67,190 9s. 6d. The net result for the half-year (after deducting the Post Office Royalties, amounting to £100,637 16s. 7d.) is a profit balance of £355,618 9s. 2d., as compared with £331,471 13s. 9d. for the corresponding period of 1904, being an increase of £24,146 15s. 5d. The rentals carried forward for unexpired terms of running contracts amount to £1,018,882 0s. 4d., as compared with £937,296 16s. 1d. at the corresponding period of 1904, being an increase of £81,585 4s. 3d. Out of the available balance of £268,615 19s. 5d. shown by the net revenue account (No. 3) the board will recommend the payment for the half-year of a dividend at the rate of 6 per cent. per annum on the first and second preference shares, 5 per cent. per annum on the third preference shares, 6 per cent. per annum on the preferred stock, and 5 per cent. per annum on the deferred stock, less income-tax in all cases. The board also propose to transfer £110,000 to the reserve fund, and to carry forward the balance of £9,699 6s. 1d. The sum of £477,156

16s. 9d. has been expended on capital account during the half-year in the erection of 22,405 additional exchange and private stations, and in the construction of underground works. At the general meeting four directors retire, and being eligible, offer themselves for re-election, viz., Mr. Charles Swain Agnew, the Rt. Hon. Lord Harris, Mr. George Hunter Robertson, and Sir Albert Kaye Rollit, M.P. The auditors, Messrs. Welton, Jones & Co., also retire and are eligible for re-election. The transfer books of the company were closed on 10th inst., and will remain closed until 20th inst., both days inclusive, and the dividend warrants will be posted on the latter date.

Shanghai Electric and Asbestos Co.—The report of the directors for the year ended March 31st, 1905, shows that an interim dividend of 4 per cent. was declared and paid in February last, on 4,859 shares; after deducting this amount, directors' and auditor's fees, and making provision for bad and doubtful debts, there remains at credit of profit and loss account $20,275.21. The directors propose to pay a final dividend of 6 per cent., making 10 per cent. for the year, $7,500; to write off furniture, fixtures and iron godowns, $1,796.59; to write off steam launch *Electra*, $1,500; to present as a bonus to the staff, $2,500; to carry forward to new account, $6,978.62.

New Issue.—The Northern Counties Electricity Supply Co., Ltd., announced this week the issue at par of £100,000 4½ per cent. first mortgage debenture stock.

The Electric and General Investment Co.—The warrants for the dividends, &c., on the founders' and ordinary shares for the year ended May 31st last, and for the distribution by the trustees of the founders and ordinary shares reserve funds have been posted.

Eastern Telegraph Co.—The accounts show a balance sufficient to pay a final dividend of 1½ per cent. and a bonus of 2 per cent., making a total distribution of 7 per cent. on the ordinary stock for the year ended March 31st, 1905.

North Metropolitan Tramways. — The directors recommend a dividend at the rate of 3½ per cent. per annum for the half-year ended June 30th last, carrying forward about £200.

British Electric Traction Co.—The directors propose to pay a dividend at the rate of 6 per cent. per annum for the half-year to March 31st, making 6 per cent. for the year.

Direct United States Cable Co.—The directors have resolved to recommend a final dividend of 3s. per share, together with a bonus of 1s. per share, both free of income-tax, such dividend and bonus to be payable on and after the 31st inst., making, with the three interim dividends already paid, a total distribution of 3¼ per cent. for the year ended June 30th last, and after placing £6,000 to reserve fund account, carrying forward a balance of about £2,525. Notice is also given that the transfer books of this company are closed from July 11th to 25th inclusive.

The St. James' and Pall Mall Electric Light Co.—The directors have declared an interim dividend on the preference shares at the rate of 7 per cent. per annum, and on the ordinary shares at the rate of 10 per cent. per annum for the half-year ending June 30th. The share transfer books are closed from July 18th to 31st inclusive.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—Newcastle-upon-Tyne Electric Supply Co., Ltd., 57,009 ordinary shares of £5 each fully paid Nos. 1 to 57,009; 17,991 ordinary shares of £5 each Nos. 57,010 to 75,000; 57,009 5 per cent. preference shares of £5 each fully-paid Nos. 1 to 57,009; and 17,991 5 per cent. preference shares of £5 each Nos. 57,010 to 75,000.

STOCKS AND SHARES.

Wednesday evening.

The Administrative County of London Power Bill, passing its second reading in the House of Commons, was the cause of a severe slump in the Electric Supply market. As will be seen from our Share List of Electricity Supply Companies, prices all along the line are lower, and in some cases the fall has been very considerable. Of course, should the Bill eventually go through, and it has many stages still to pass, some of the companies will be affected more than others. This fact, however, seems to have been overlooked in the rush to sell shares, and one company has suffered the same as another in the general decline. During the past day or two, however, the market has been rather more steady, as the public are getting over their first spasm of nerves, and knowing ones are picking up cheap parcels of shares whenever the opportunity presents itself. It is quite unnecessary, and would only be tedious to our readers, for us to remark on each concern separately. Movements range from 2s. 6d. to £1, and are all downwards, except for a rise of 1 per cent. in London Electric Debenture to 99-102 on a strong demand for the stock with none offering. St. James's were quite unaffected by the announcement of the interim dividend at the rate of 10 per cent.

Holders of Chelsea Founders' shares are advised that the Royal Assent having been received on June 30th for the cancellation of these shares, they must send in their certificates by the 29th inst. in order to receive in exchange a certificate for 10 Ordinary shares for every Founder's share. The dividend on these Ordinary shares for 1905 will be half of that paid on the existing shares, after which they will rank *pari passu*. The transfer books of the Founders' shares were closed on the 30th of last month.

The Bill to include the borough of Stoke Newington in the area of supply of the North Metropolitan Electric Power Co. was allowed by a Select Committee of the House of Commons to proceed as unopposed.

Calcutta Electric Supply shares continue to attract attention, and the price keeps firm at 9⅛-⅜. The company reports that the sale of electricity during the week ended June 16th amounts to 113,229 units as compared with 78,730 in the corresponding week last year.

We are given to understand that application has been made to the London Stock Exchange for a quotation for River Plate Electricity Ordinary and Preference shares and Debenture stock. During the past six months or so an enormous business has been put through in the securities of this company, so that an official quotation will be very welcome to both shareholders and dealers alike.

A good enough investment in its way is the issue made by the Northern Counties Electricity Supply Co. of £100,000 4½ per cent. First Mortgage Debenture stock at par, the subscription list for which was closed on Tuesday last. The prospectus reads well, and shows the company is making rapid headway.

No. 3 of a little publication by the South Wales Electrical Power Distribution Co., called "Electrics," has been issued, and like its predecessors, is an interesting booklet. Its compilation is, of course, more or less technical, but the "man in the street" will find some useful reading in its pages.

As regards Underground Electric Railways, a good deal of liquidation has taken place during the past week in Metropolitans and Districts, owing to the fall in prices in the South African market; several holders of the Railway Stocks having to realise in order to meet their Kaffir differences. It is significant to note that the contango rate on "Mets." last Tuesday was only ⅛ per cent., after having been ¼ per cent. for many accounts past. The City and South London dividend, which it is expected will be announced next week, is anticipated by dealers to be 1¾ per cent. Should this be the case, the yield to an investor at the present price of the stock would be, as nearly as possible, 4⅜ per cent., which, considering the prospects of the company, makes the Stock look a more or less cheap investment. The weak spot in the Electric Railway market is Central Londons, the company already beginning to feel the effect of the District electrification. Stock has been freely offered in the market, but jobbers object to put any amount on their books. A very fair amount has been put through in Great Northern and City £10 fully paid preferred shares, round about 5.

The principal movement in manufacturing concerns has been the fall in Electric Construction shares on the passing of the Ordinary dividend. The report states that competition has been extremely keen, and this is no doubt the cause of all the trouble, but all the same to shareholders a net profit of only £3,908 against £14,773 for the corresponding twelve months is very disheartening. The Ordinary shares were marked down to 10s., and the Preference to 2.

British Election Traction Ordinary shares hardened fractionally on the announcement of the dividend of 6 per cent. for the year, being at the same rate as for the previous twelve months. The report is looked forward to with considerable interest by dealers in the market. The Preference shares are just the turn lower at 11⅛-⅝, and the 4½ per cent. Second Debenture has been put down 1 per cent. to 97-99. Edison & Swan £3 paid shares were offered in a small way, and fell ⅛ to 1¼. Callender Preferences rose ⅛ to 5⅛-¼, Henley Preferences receding to the same extent to 5⅜-⅝.

In Telegraphs and Telephones the general tend of prices has been downwards, but the market is not by any means weak. On the whole, there are very few alterations to record, our list of quotations only numbering about half a dozen movements. Anglo-American Preferred stock is down ½ per cent. to 106-107, and the Deferred is ¼ lower at 14½-¾. Globe Trusts are ½ off at 10⅜-⅝. National Telephone securities were unaffected by the announcement of the 5 per cent. dividend on the Deferred stock for the past half year. United River Plate Telephones have shed ¼, to 6¾-7¼. On the other hand, Great Northerns have risen £1, to 34-36.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1902.	1903.	1904.	Closing Quotations July 5th.	Closing Quotations July 12th.	Business done week ended July 12th, 1905. Highest	Lowest.
34,800	African Direct Telegraph, 4 % Debs.	100	4 %	4 %	4 %	98 —101 xd	98—101 xd	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	2¼— 2⅜	2¼— 2⅜	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	70 — 75	70 — 75	..	..
768,580	Anglo-American Telegraph	Stock	60/6	61s.	2⅜%	59 — 61	59 — 61	..	..
3,118,210	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5¾%	106¼—107½	106 —107	107½	106¾
3,118,210	Do. do. do. Deferred	Stock	1/-	2s.	Nil	14⅜— 15	14¼— 14½	14½	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	6⅝— 7⅛	7 — 7¼	7 3/32	..
15,000,000$	Commercial Cable	$100	8 %	8 %	8 %	..	..	..	..
1,932,856£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	4 %	4 %	4 %	96½— 98¼ xd	96¼— 98¼ xd	97½	97½
16,000	Cuba Telegraph	10	6½%	10 %	5 %	8 — 8½	8 — 8½	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	17 — 18	17 — 18	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	3⅜— 3⅝	3⅜— 3⅝	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	9 — 9½	9 — 9½	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	100 —103 xd	100 —103 xd	..	..
60,710£	Direct United States Cable	20	3½%	3 %	3½%	11⅜— 11⅝	11⅜— 11⅝	11⅝	11⅜
74,500	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	99 —101 xd	101 —103	100	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	141 —144	141 —144	144	142
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	..	90 — 92	90 — 92	90⅝	..
1,836,814	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	107 —109	107 —109	108½	107½
300,000	Eastern Extension, Australiasia, and China Telegraph	10	7 %	7 %	7 %	13⅜— 14¼	13⅜— 14¼	14⅜	13⅜
602,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	105¼—107½	106 —108	..	..
300,000	Eastern & South African Tele., 4 % Mt. Db., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	100¼—102½	101 —103	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	100¼—102¼	100¼—102¼	100¼	..
180,887	Globe Telegraph and Trust	10	£3 16 7*	5½%	5⅝%	10¼— 10⅝	10⅜— 10⅝	10⅝	10 7/16
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14¼— 14½	14¼— 14½	14 7/16	..
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	24 %	33 — 34	34½— 35½	34½	33⅝
46,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	99 —101 xd	99 —101 xd	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	49— 51	49½— 51½	50½	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	..	2 — 2 1/16	2 — 2 1/16	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	111½—112½	111½—112½	112½	111⅝
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	102 — 104	105½ 107½	106	102
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13⅜	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
250,000	Do. do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5 1/16	..
2,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —101 xd	99 —101 xd	100	..
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101½—103½ xd	102 —104 xd	103½	102
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6½%	6½%	1⅛— 1⅛	1⅛— 1⅛	1⅛	..
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	1 1/16— 1 1/16	1 1/16— 1 1/16	..	..
100,000	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	97 —100 xd	97 —100 xd	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	7⅛— 8	7⅛— 8	..	..
3,237	Submarine Cables Trust	Cert.	6 %	6 %	6 %	125 —128	126—129	..	..
58,000	United River Plate Telephone	5	7 %	8 %	8 %	7 — 7½	6⅞— 7⅛	7 1/16	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 — 5⅛ xd	5 — 5⅛ xd	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	106 —108 xd	108 —110 xd	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	8¼— 9	8¼— 9	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,008	2½	Nil	Nil	Nil	7/16— 9/16	7/16— 9/16	..	..
150,000	West Coast of America, 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	99 —101 xd	99 —101 xd	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	7 %	13½ — 14 xd	13¼— 14 xd	13⅝	13⅜
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	100 —102 xd	100 —101 xd	..	..
563,380	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103 xd	101 —103 xd	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	⅛— ⅜	⅛— ⅜	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	8 — 8½	8 — 8½	8 3/16	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	5¾— 6¼	5¾— 6¼	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	101 —104 xd	101 —104 xd	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

40,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	4⅜— 5⅛	4⅜— 5⅛	5⅛	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	4⅛— 5⅛	4⅛— 5⅛	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	2⅝— 3⅛	2⅝— 3⅛	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	100 —104	100 —104	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	9¼— 9⅝	9⅜— 9⅝	9⅝	9 5/16
156,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	11⅛— 11⅜	11⅛— 11⅜	11⅜	11⅛
1,000,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	5 %	5 %	5 %	122 —124	122 —124	..	..
250,000	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	98 —100	97 — 99	98½	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	5⅝— 6	5⅝— 6	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	5⅝— 6	5⅝— 6	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	101 —104 xd	101 —104 xd	102	..
50,000	¶ Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	1/16— 1/8	1/16— 1/8	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	¼— ⅜	¼— ⅜	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	1 — 1¼	1 — 1¼	1 1/32	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	92 — 95	92 — 95	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	77 — 80 xd	77 — 80 xd	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10 — 11	10 — 11	10⅞	..
40,000	Do. do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5⅜— 5⅝	5⅛— 5⅜	5⅜	..
300,000	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	106 —108	106 —108	107¼	..
1,963,208	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	90 — 92	90 — 92	92½	91½
523,396	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101 —103	101 —103	102⅝	102
523,396	Do. do. Def. do.	Stock	4 %	4 %	4 %	78 — 81	78 — 81	..	..
1,330,000	City and South London Railway	Stock	3½%	2⅜%	2⅜%	39 — 41	39 — 41	40⅛	39
85,000	Crompton & Co., Nos. 1 to 85,000	3	5 %	2½%	..	1⅝— 2⅛	1⅝— 2⅛	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	94 — 99 xd	94 — 99 xd	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	1¼— 1½	1¼— 1½	1	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	Nil	..	2 — 2⅛	2 — 2⅛	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	83 — 88 xd	83 — 88 xd	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	89 — 94	89 — 94	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	¾— 1	¾— ⅞	⅞	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	2¼— 2½	1⅞— 2⅛	2⅛	1 31/32
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	4 %	4 %	4 %	95 — 98	95 — 98	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9½— 10 xd	9½— 10 xd	..	..
200,000	Do. do 4 % Mort. Deb.	Stock	4 %	4 %	4 %	97 —101	97 —101	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	11⅜— 12⅜	11⅜— 12⅜	12⅛	11 13/16
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	5¾— 6⅛	5⅝— 6⅛	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	109 —111	109 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	15½— 16½ xd	15½— 16½	15½	..
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	100 —103	100 —103	..	..
37,500	† Liverpool Overhead Railway, Ord.	10	1½%	1⅝%	1½%	3¼— 3½	3¼— 3½	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	9¼— 9¾	9¼— 9¾	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	31 — 33	31 — 33	32½	31
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	101 —103 xd	101 —103 xd	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3⅛%	3⅛%	3⅛%	90 — 92	90 — 92	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 2½ per cent. (March 9th. 1905).

SHARE LIST OF ELECTRICAL COMPANIES *(continued)*.—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1902.	1903.	1904.	Closing Quotations July 5th.	Closing Quotations July 12th.	Business done week ended July 12th, 1905. Highest	Lowest.
		‡							
29,377	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	8 %	10 %	10 %	9⅜—10¼	9 —10	9⅝	..
10,623	Do. do. 7 % Cum. Pref. ..	5	7 %	7 %	7 %	9¼—10¼	9 —10	..	..
288,782	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	103 —106	103 —106	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	7⅜— 8	6¾— 7½	7	6⅞
80,000	Do. do. do. 4½ % Cum. Pref. ..	5	4½%	4½%	4½%	5¼— 5⅜	5¼— 5⅜	5⅜	5⅜
40,000	Do. do. "City Undertaking" 4½ % Cum. Pref. ..	5	4½%	4½%	4½%	4¾— 5¼xd	4¾— 5 xd	4⅛	..
40,000	Do. do. 1903	5	..	4½%	4½%	4¾— 5¼xd	4¾— 5 xd	4⅜	..
350,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	105 —107	104 —106	105¼	..
44,496	*Chelsea Electricity Supply, Ord.	5	4½%	5⅜%	6 %	6¾— 6⅞	5¾— 6¼	6	..
150,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	108 —110 xd	108 —110 xd	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595.	10	5 %	5 %	6 %	10⅜— 11¼	10¼— 11¼	10⅝	10½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13¾— 14¼	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	5 %	5 %	5 %	122 —126 xd	122 —126 xd	..	..
300,000	Do. 4½ % 2nd Deb. Stock, Prov. Certs., all paid	100	4½%	4½%	4½%	103 —105 xd	103 —105 xd	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	8¾— 8⅞	7¾— 8¼	..	..
30,000	Do. do. do. 6 % Pref., 40,001—60,000 ..	10	6 %	6 %	6 %	12⅜— 12⅝	11¾— 12¼	12¼	12⅜
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	112 —115 xd	111 —114 xd	111½	111
250,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	103 —105	103 —105	103¼	..
70,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	5¾— 6¼	5¾— 6¼	6	5⅞
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 — 6¼	6 — 6¼	6	..
300,000‡	Do. do. 4½ % 1st Mort Deb. Stock ..	100	4½%	4½%	4½%	107 —109	107 —109	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12 %	12 %	11⅛— 12⅛	10⅞— 11¼	11¼	..
136,000	Do. do. do. 4 % Debenture Stock ..	Stock	4 %	4 %	4 %	101 —103	98 —101	100½	100
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	2 — 2⅛	1¾— 2⅛	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	5 — 5⅛	4¾— 5⅛	..	..
371,895	Do. do. do. 4 % 1st Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	98 —101	99 —102	100⅜	..
100,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8¾%	10 %	9⅛— 10	9¼— 9⅜	9⅜	9¼
76,121	Do. do. 4½ % Cum. Pref. 1—71,106, £3 paid ..	5	4½%	4½%	4½%	5⅝— 5⅞xd	5⅝— 5⅝	5⅞	5½
220,000‡	Do. do. 4½ % 1st Mort. Deb. Stock	..	4½%	4½%	4½%	109 —113 xd	109 —113 xd	111	..
250,000‡	Do. do. 3½ % Mort. Deb. Stock Red.	Stock	3½%	3½%	3½%	98 —100 xd	98 —100 xd	100½	99⅝
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	99 —101 xd	99 —101 xd	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	14¼— 15½	14 — 15 xd	..	..
59,000	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	100 —102	100 —102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14⅓%	14⅓%	14⅓%	13¾— 14¼	13¾— 14¼	13½	13
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	8¾— 9	8 — 9	8⅝	..
150,000‡	Do. do. do. 3½ % Deb. Stock Red. ..	100	3⅓%	3⅓%	3⅓%	97 — 99 xd	97 — 99 xd	98¼	98
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	2⅝— 3⅛	2⅝— 2¾	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	79 — 83	79 — 83	..	..
65,000	South London Electricity Supply, Ord.	5	1⅔%	3 %	4 %	3⅜— 4¼	3½— 4	3⅜	..
100,000	South Metropolitan Electric Light and Power (Ord ..	1	Nil	Nil	Nil	⅞— 1	⅞— 1	..	..
50,000	*(Late Blackheath and Greenwich* 7 % Pref. ..	1	Nil	7 %	7 %	1¼— 1⅜	1¼— 1⅜	..	..
100,000	*Dist. E.L.Co.)* 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	105 —108	105 —108	..	..
30,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	4⅝— 4⅞	4⅜— 4⅝	4⅞	..
30,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	..	..
200,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	100	..	..	4½%	104 —106	104 —106	104½	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13⅓%	14 %	12⅛— 13	11¼— 12¼	12¼	11¼
28,151	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	6¼— 6¾xd	6⅛— 6⅜ xd	..	..

Shares not officially quoted:—Mackay Companies, ord., 40—41. Pref. 74—75.

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, July 12th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	32/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ...	per ton	£30	..
a	Bleaching powder	per ton	£5 5	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90 %)	per gal.	7/-	..
a	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£20	..
a	Lead, Nitrate	per ton	£25	..
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a	Potassium Bichromate, in casks	per lb.	3d.	..
a	Potash, Caustic (75/80 %) ..	per ton	£22	..
a	Potassium Cyanide	per lb.	7½d.	..
a	Shellac	per cwt.	147/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£3	..
a	Sodium Bichromate, casks ..	per lb.	2½d.	..
a	,, Cyanide	per lb.	7d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£130	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
b	Babbitt's metal ingots	per ton	£43 to £140	..
c	Brass (rolled metal 2' to 12') basis	per lb.	7¼d.	..
c	,, Tube (brazed)	per lb.	9¼d.	..
c	,, ,, (solid drawn) ..	per lb.	8¼d.	..
c	,, Wire, basis	per lb.	7¾d.	..
c	Copper Tubes (brazed)	per lb.	10¼d.	..
c	,, ,, (solid drawn) ..	per lb.	10¼d.	..
g	Copper Bars (best selected) ..	per ton	£80	..

	METALS, &c. *(continued)*.		Latest Price.	Fortnight's Dec. or Inc.
g	Copper Sheet	per ton	£80	..
g	,, Rod	per ton	£80	..
e	,, (Electrolytic) Bars ..	per ton	£70 10	..
e	,, ,, Sheets ..	per ton	£87	..
e	,, ,, Rod ..	per ton	£81	..
e	,, ,, H.C. Wire	per lb.	9½d.	..
	Ebonite Rod	per lb.	3/3	..
	,, Sheet	per lb.	3/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha, fine	per lb.	6/- to 7/-	..
h	India-rubber, Para fine	per lb.	5/4½ to 5/5½	dec.
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	45/6	½d. dec.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£13 15 to £13 17 6	5/- inc.
g	,, ,, Sheet	per ton	£15 10	5/- inc.
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£7 7 6	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d	,, ,, medium	per lb.	2/6 to 4/-	..
d	,, ,, large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/1 to 1/3	..
p	,, rolled bars & rods	per lb.	1/1 to 1/3	..
p	,, ,, strip & sheet	per lb.	1/3	..
o	Platinum	per oz.	84/-	..
e	Silicium Bronze Wire	per lb.	10½d. to 11½d.	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£142 10 to £143 10	40/- to 50/- inc.
n	,, Wire, Nos. 1 to 16	per lb.	1/8	..
p	White Anti-friction Metals— "White Ant" brand	per ton	£43 to £65	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	,, 6 lea. Flax	per lb.	5¾d.	..
j	,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4¾d.	..
j	,, 180 lbs. Jute rove	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£27 15	7/6 inc.

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons, Ltd.; *d* F. Wiggins & Sons; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

"Zorene."—On the 6th inst. a demonstration of this material was given at the Westminster Palace Hotel by a foreign gentleman, who was addressed as "Doctor," and, according to the *Evening News*, has a Chair at Brunn University. Its composition is the Doctor's secret, but it appears to be some form of coal tar product and an acid. Applied to wood, rope, stone, iron, steel, slag, &c., Zorene is claimed to render them more dense or waterproof or rustproof, according to their quality. It is claimed that Zorene will penetrate even so dense a substance as hard granite, and that it forms a compound with water or as the result of the presence of water, which fills the pores of the material with a vulcanised substance. That Zorene does waterproof surfaces it has been applied to may be conceded as the result of dipping treated articles in water, but we could detect no sign of the alleged penetration even of a porous sandstone, and we consider that too much has been claimed. Bright iron will not rust if covered with a skin of varnish, so that treatment with Zorene may not amount to more than a surface lacquering. We are informed that a committee is to be formed of independent engineers and others to make thorough tests of Zorene. The necessity for such a committee was, we are inclined to think, demonstrated by the demonstration, for it should certainly be made quite clear whether the claims made for Zorene can be substantiated. Its penetrative power in particular was not by any means proved, nor so far is there any proof of the endurance of the treatment longer than paint, creosote, &c.

NEW ELECTRICAL ENGINEERING LABORATORIES, LIVERPOOL UNIVERSITY.

The new Laboratory of Electrotechnics in connection with Liverpool University was opened on Saturday afternoon last, the event being one of much scientific interest in the North. Before the opening of the laboratory, the Degrees of the University were conferred on the successful candidates by the Chancellor of the University, the Right Hon. the Earl of Derby, K.G., G.C.B., LL.D., at a large and influential gathering in St. George's Hall. The ceremony of opening the new laboratory was performed by Sir Joseph Wilson Swan, M.A., D.Sc., F.R.S., and was of a two-fold character. After the Degrees had been conferred at St. George's Hall, Sir Joseph delivered an address in which he reviewed the progress made by electrical science during the last 25 years, especially in the domain of electrical engineering, in which an amount of capital was engaged which Mr. Gaeke reckoned at 230 millions sterling; how far it was going to extend it was impossible to say. Electrical industries had a close relation with another industry, that of chemistry, and in that neighbourhood they had examples of it; he referred to the electrical production of sodium, soda and chlorine at Ryncorn. Sir Joseph proceeded to allude to the new laboratory, and closed his remarks by expressing the hope that it might be of use not only to the students, but also to the University and to the world.

The new laboratory is situated in Brownlow Street, and here, in the lecture theatre, Sir Joseph Wilson Swan addressed a crowded assembly on the position and objects of the laboratory, and expressed the earnest wish that prosperity might attend those who taught in it and those who worked in it.

Electrotechnics has been taught at Liverpool for the last 12 years, first at University College, and latterly at the matured University of Liverpool. For the first seven years of the 12, electrotechnics formed a branch of the department of physics, and was under the control of the Professor of Physics. The work was carried on in temporary premises adjoining the original building of University College. In the year 1900 a lectureship of electrotechnics was established, and Dr. E. W. Marchant was shortly afterwards appointed lecturer to this department. At that time efforts were being made to establish a University of Liverpool, and funds were being raised for that object. Among the donors to the funds was Mr. David Jardine, of Liverpool, who contributed the sum of £10,000, expressing the wish that the money should be used to endow a Chair of Electrotechnics. Such a chair was, accordingly, established, and the professorship was offered to Dr. Marchant, who accepted the position. Steps were then taken to provide a suitable home for the work of the department, and the building of the new laboratory was erected from the designs and plans prepared by Messrs. Willink & Thicknesse, Liverpool. The contractors for the building work were Messrs. William Thornton & Sons, Liverpool. A sum of £12,000 was advanced from the University Fund to defray the cost of the building, and a sum of £1,000 was provided by the Lancashire County Council towards the cost of fitting up the laboratory.

The new laboratory has a plain front, showing four stories and a basement, and is constructed of brick with stone dressings. An arrangement has been made by which, for the time, the large basement of the natural history and botanical laboratory adjoining will be used for electrotechnics, and the two upper stories of the new laboratory building will be used for geological work.

A dynamo room measuring about 60 ft. × 56 ft. was constructed in the basement, the walls being lined with white glazed bricks. The heavier machines stand on brick beds furnished with foundation rails, some 16 in. above the level of the concrete floor.

The principal source of electrical power in the laboratory is a Westinghouse standard direct-current four-pole generator giving 22½ KW. at 230 volts, to run at 300 r.p.m. This is driven by a Westinghouse two-cylinder vertical gas engine. The set is intended mainly to supply current for lighting the building, but it will also be used to charge a battery of 58 cells which has been installed in a room on the ground floor. The item of next importance in the dynamo room is a fully-equipped electric tramcar truck of Schuckert pattern and construction, which has been presented to the laboratory by the Corporation of Liverpool. The truck has two Schuckert motors of 25 H.P. each, and a controller by the same makers. Among the other machines in the room are two single-phase generators and a two-phase motor-generator, by Witting & Eborall; a direct current generator of 55 volts × 85 amperes at 960 r.p.m., by Siemens Bros.; a three-phase generator with 10 poles, by Fuller & Wenstrom; a rotary converter of 460 volts × 22 amperes, to run at 1,500 r.p.m., by the same makers; a Johnson-Phillips dynamo of 55 volts × 80 amperes; and a Heyland single-phase motor. Other machines have been lent to the laboratory by the Lancashire Dynamo and Motor Co., J. H. Holmes & Co., Crompton & Co., and other firms. The dynamos are worked by motors driven by current obtained from the Corporation mains. Driving is done chiefly by belts, shafting and pulleys, but it is intended to substitute direct driving by motors for the belt system.

If necessary, current for lighting the building can be obtained from the city electric mains, but ordinarily it will be obtained from the generator worked by the gas engine. It is contemplated to make free use of the lighting system of the building for demonstration purposes, the system being regarded as a load which may be varied to suit the work in hand.

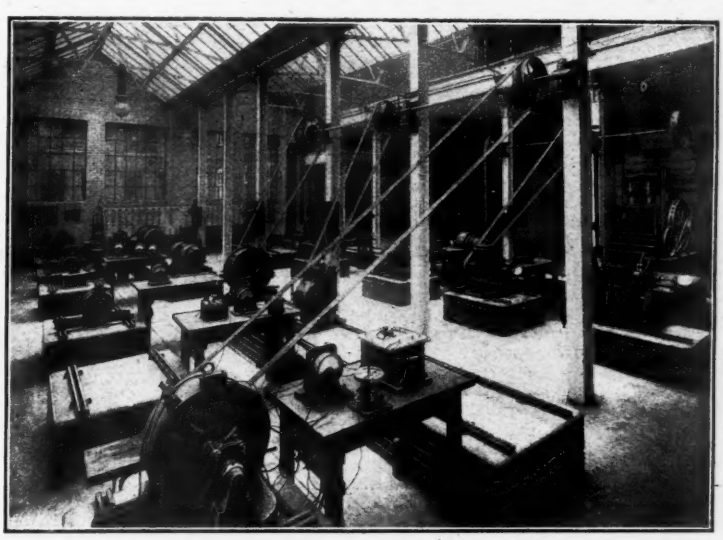
The available energy will be distributed and controlled chiefly by two main switchboards, which stand at one end of the dynamo room. One of these will control the supply for lighting. This board is of slate, and has two panels, black enamelled on the front, carrying a change-over switch by which the supply can be taken from the city mains or from the principal generator, three direct current meters of the International Electric Co.'s manufacture, and three N.C.S. ammeters.

The second switchboard is intended for general use by the students. It consists of four panels of marble, each furnished with a number of screw terminals. From the back of the board wires lead to the principal rooms. By this means any machine may be brought into communication with a particular class room, or with the lecture room.

A spacious and well-fitted workshop adjoins the dynamo room The chief machines which it now contains are a planing machine, a drill and two lathes, belt-driven by a 2-H.P. British Thomson-Houston motor.

A laboratory for senior students, 34 × 28 ft., has been fitted up in the basement for the study of transformers and alternating currents. Two three-phase transformers of Witting & Eborall's core type, and a synchronous motor of Mather & Platt's construction are installed.

High-tension work will be carried on in a room 35 ft. × 13 ft., also in the basement. A 20,000-volt transformer of Witting and Eborall's oil-cooled pattern has been provided for work of this kind. The testing of insulating materials for "breakdown" strains will be done here. An adjoining room has been set apart for the testing of iron and steel for magnetic and other properties. Galvanometers, permeameters, and other instruments for work of this kind have been provided.



One of the New Electrical Engineering Laboratories, Liverpool University.

A museum has been established in a well lighted room in the basement.

The testing of electric lamps will be carried on in two rooms in the basement, in which suitable apparatus has been installed for carrying on life tests at constant pressure, the latter being automatically regulated within 1 part in 400. The generator employed is driven at constant speed by a motor which receives current from the main battery. A room has been set apart for photometry.

Another room will be provided with standard instruments, which will be compared periodically with the standards at the National Physical Laboratory. A small battery consisting of some 20 cells will be installed for use in this room.

Two other rooms in the basement, each 27 ft. × 20 ft., will be used for original work. One of these contains a Duddell high-frequency oscillograph. The second room will be used as a motor-testing room, and a switchboard has been provided, by which current can be obtained from the dynamos or from the main battery.

Dr. Marchant's office and private experimenting room are on the ground floor, and on this floor there is a galvanometer room. Eight galvanometers, made by the department, are now in use in the laboratory, and there are also three ballistic galvanometers—two of Crompton & Midgett's construction, and one of Nasmyth & Mather's. For Wheatstone bridge work and other special observations, a galvanometer by Nalder Bros. & Thompson will be employed.

A room on the ground floor will be used as a junior laboratory, and possesses a marble switchboard fitted with screw terminals. In

an adjoining room, at the back of this board, the main battery of the laboratory is situated. The battery consists of four sets of 10 cells each, and two sets of 9 cells each, the cells being of Chloride, Tudor and Electrical Power Storage Companies' types. The cells are connected with the terminals of the switchboard.

A lecture theatre which will seat 130 persons has been provided on the first floor. In another room on this floor there is a Duddell oscillograph, and provision has been made by which any dynamo in the dynamo room may be connected with this room. A library and reading room will be established on the same floor.

The electrical fittings, throughout, were supplied by Messrs. John Hunter & Co., Liverpool.

A special feature of the laboratory and its arrangements, is the provision which has been made by which the different generators, batteries and more important instruments can be utilised in the lecture room and other rooms for demonstrating purposes, through the system of wires and terminals which has been adopted.

THE EFFECT OF STEAM JACKETING ON EFFICIENCY.

THE author of a paper on this subject, read at the Liége meeting of the Institution of Mechanical Engineers, is Mr. A. L. Mellanby, of Manchester School of Technology, and he belongs to that school of thought which would have us believe that the effects of condensation in the steam cylinder are due, not to condensation, but to leakage past the valve. This demands that we should abandon the belief that the interior surface of the cylinder, &c., suffers a very considerable range of temperature when in contact with steam of varying temperature. It asks us to believe that while valves leak steam from the steam chest into the cylinder, the piston kindly refrains from any such amount of leakage.

It is at least certain that there is usually more steam present, as steam, in a cylinder at the end than at the beginning of the expansion. From D. K. Clark and Hirn onwards this has been reasonably explained by cylinder condensation, and the newer school do not appear so far to have advanced equally cogent reasons for their new theory. Our present author also does not seem consistent in his findings, as we shall see later. It is well proved by years of experience that the jacket will secure economy according to its conditions. Watt understood the jacket, or he would not have used it as an antechamber to the cylinder.

By so doing he transferred condensation from the cylinder to the jacket, whence it could be drained without re-evaporation. Men who do not understand steam may be heard to rail at the Watt jacket on the ground that it is folly to cool the steam by passing it through a jacket in hopes of making the same steam act better in the cylinder. Such an argument, of course, arises from an entire misconception of the properties of saturated steam and its behaviour in the jacket and in the cylinder. The inconsistency of the position to some extent comes in the fact that the use of jackets in the present case was to lessen the steam consumption of the engine. This points to a reduction of cylinder condensation, not to reduced leakage.

The engine tested was a little one of the compound horizontal side-by-side type, with cylinders 11½ and 20 × 36-in. stroke, and with Corliss valves to the H.P. and slide valves and Meyer plates to the L.P. cylinder. In order to magnify the effect of the jackets, it was run at about 60 r.p.m., or half its normal speed, and tests were made at 8·1, 12·3, 18·0 and 25 expansions with and without jackets, the L.P. cut-off remaining fixed throughout.

The effect of jackets at 25 expansions was such that while 163 lb. of steam was condensed in the L.P. steam chest when jackets were off, this was reduced to 129 lb. with steam in the H.P. cover jackets, and to 99 lb. with steam in all cover and barrel jackets. The H.P. cover jacket condensed 66 lb. when it alone was acting, and 46 lb. when all jackets were acting. Without jackets the engine used 1,603 lb. of steam per hour. With H.P. cover jackets only, it used only 1,569 lb., including the jacket, and with all jackets on it used 1,693 lb. Taken alone these figures would show the H.P. cover jackets to be worth about 2 per cent., and all the jackets to be a loss of 6 per cent. But the I.H.P. in each case was 81·0, 78·0 and 92·0, and the steam per I.H.P.-hour 19·75 lb.; 20·1 lb. and 18·35 lb. Now, if these figures mean anything, they mean that the H.P. jacket prevented a lot of condensation in the H.P. cylinder, and the engine was therefore kept so short of steam that, instead of a mean pressure of 8·4 in the L.P. cylinder there was only 7·3. When, however, jackets were steamed throughout the engine, such water as there was condensed in the first cylinder was re-evaporated by them, and the mean pressure in the L.P. cylinder was raised to 13·0 lb. ! ! ! and the mean referred pressure in the three trials was 24·7, 23·6 and 28·3.

The steam fed to the H.P. cylinder was respectively 0·452, 0·421 and 0·415 lb., and to the L.P. cylinder 0·406, 0·385 and 0·387 lb. per revolution, the difference being, of course, drained from the jackets. At 18 expansions the use of the H.P. cover jackets made the engine a mere fraction less economical per I.H.P.-hour, and the most economical result was when the L.P. barrel jackets were off.

At 12·3 expansions the H.P. cover jackets did succeed in producing economy, and again the best result was with the L.P. barrel jacket off, but it was only as 17·2 to 17·3 better than with all the L.P. jackets off.

Again, at 8·1 expansions the best result was with all jackets on, and the next best with all off.

It is clear that, at least as regards this particular engine, the benefit of jacketing arises from more steam, as steam, and less steam, as steam and hot water, being passed through the L.P. cylinder, and the figures appear to be a powerful argument in support of the established theory that cylinder condensation, and not leakage, is the responsible factor in reducing engine efficiency.

As with superheating so with jackets, less steam can get into an engine with a given cut-off. Given a fixed cut-off to the first cylinder, more work can only be got out of an engine by using the cylinders as a continuation of the boiler to which end one would omit H.P. jackets, and thoroughly jacket the receiver and L.P. cylinder. The H.P. cylinder might even with advantage at times be specially cooled in order to admit more steam for subsequent re-evaporation. Wasteful, of course, as such a practice would be, it would enable a maximum of power to be got out of an engine; with superheated steam a later cut-off may be necessary, unless the benefit of superheat is sufficiently great to extend to the increasing of the mean pressure in the L.P. cylinder.

We regret the author of this paper did not extend his researches in this direction. A few trials would be interesting to show how far the effect of superheat will extend in the direction of a higher mean pressure with less steam, to obviate the necessity of any later cut-off in the first cylinder. It is news to us, however, that it is the "general opinion that the temperature of the cylinder walls *follows* that of the piston, and that at the end of release the walls are cooled down to the exhaust temperature." We admit the *follows* but the sequel depends entirely on the speed, &c. The steam has a certain range of temperature, and the cylinder wall is always attempting to attain the same temperature, and succeeds partially at every speed, perhaps wholly at very low speeds. It seems absurd to haggle over such a matter. Time is so essential to the equalisation of temperature in even closely contiguous bodies, that we cannot imagine how the instantaneous coincidence came to be set up by the author, unless purely for the fun of arguing it down. If leakage is the serious matter claimed by the author, it is curious how the jacketing of the H.P.-cylinder cover should so seriously diminish it.

Though jackets are more or less obsolete, these tests are useful as an addition to the knowledge of steam behaviour, though we read the figures differently from the author. It is, of course, true that there is leakage; it is equally true, probably, that leakage takes place as water, not as steam, and, therefore, that superheating should be a cure for both the faults of leakage and of cylinder condensation.

We quite agree with the conclusion of the author that with 150-lb. boiler pressure the mean referred pressure should be, at least, 40 lb. for best efficiency per B.H.P., the very usual method of judging an engine by its I.H.P. always showing the apparently best economy at a lower mean pressure per I.H.P. than per B.H.P.

The impossibility of getting full economical load upon a compound engine with a low load factor points to the probability of better results being obtainable from simple engines, especially with superheated steam. If cylinder condensation were of the small importance that some have lately attempted to show, there would scarcely be so early a limit set by practice upon the ratio of expansion. It is because of cylinder condensation that engines must be kept small.

A NEW METHOD OF TESTING ALTERNATORS.*

THE testing of large alternators under normal full-load conditions is troublesome and expensive, even when the necessary amount of energy is available, and many suggestions, such as those of Mordey and of Behrend, for reducing the power wasted during the test have been made. These methods necessitate alterations in the connections of either the armature coils or the magnet coils; if serious mechanical stresses are to be avoided, they can only be employed with machines having very large numbers of poles, and even then the magnetic conditions are not accurately the same as those which exist at normal full load. The method described below involves no change whatever in the connections of the machine, and requires the expenditure of only sufficient energy to cover the losses of the machine, and yet every part of the alternator reaches the same temperature as it would after a real full-load heating test. The method involves a previous knowledge of the separate losses of the machine, but these are, in any case, determined in the ordinary course of a systematic test.

Suppose a certain machine has—

a friction loss of 10 KW.,
an armature c^2R loss of 20 KW.,
and an iron loss of 100 KW.

In the course of an hour's run at full load the loss of energy will be:—

10 × 60 = 600 KW.-minutes as friction,
20 × 60 = 1,200 KW.-minutes as c^2R loss in armature,
100 × 60 = 6,000 KW.-minutes as iron loss.

Let the machine run for five minutes with the armature short-circuited, and at such an armature current that the armature c^2R loss is 60 KW., *i.e.*, at a current equal to $\sqrt{3}$ times the normal current. Next let the machine run for a further 10 minutes with open arma-

* Abstract of an article by Messrs. Hobart and Punga in the *Elektrotechnische Zeitschrift* for May 11th, 1905.

ture circuit, but over excited, so as to give an iron loss of 150 KW. If this cycle of operations is repeated regularly throughout the time of the test, it is obvious that—

$10 \times 60 = 600$ KW.-minutes will be lost in friction per hour,
$60 \times 20 = 1{,}200$ KW. " " in armature C^2R watts "
$150 \times 40 = 6{,}000$ KW. " " in the iron "

or exactly the same loss in each case as would have occurred under normal full load in the same time. There is still the loss in the magnet windings to be considered. During the short-circuit test this will be less, and during the open-circuit test it will be greater than the normal, so that on the average it will not differ very greatly from the normal. If, however, great exactness in this respect is required it can be obtained as follows:—

In the above example one-third of the time of each period of the test was devoted to the short-circuit test and two-thirds to the open-circuit test. These proportions can, however, be changed at will, and by varying the short-circuit current and the over-excitation correspondingly, the total energy expended in the armature copper and iron per hour can be kept at the right value whilst the average exciting energy will have some other value than before. Except in very extreme cases (*e.g.*, in the case of alternators which require only a very small change in excitation between no load and full load, and which at the same time have a very low value for the ratio $\frac{\text{short-circuit current at full excitation}}{\text{normal full-load current}}$), it will always be possible so to adjust the two time intervals that, whilst keeping the C^2R loss and the iron loss per hour at the correct value, the exciting loss per hour shall also have exactly the same value as at normal full load.

The writers, in fact, show how, with the aid of a curve connecting exciting watts with the corresponding iron losses on open circuit, and on the assumption that the ratio of short-circuit current at full excitation to normal full load current is known, the exact proportions of each period to be given to the short circuit and open circuit tests respectively, as well as the exact values of the short-circuit current and of the over-excitation to be employed, in order to keep not only the armature loss but also the field los right, can be determined. This exactness would, however, hardly seem necessary, as, in any case, a simple calculation will always enable the temperature rise of a field coil at the correct full-load loss to be determined from the temperature rise measured at some other known number of watts.

The well-known fact that the armature iron losses are always somewhat greater at full load than at no load with the same terminal voltage, is approximately allowed for in the above method of test. As La Cour has shown, the full-load iron losses are fairly well represented by the sum of the no-load iron losses and the iron losses with short-circuited armature, so that the iron losses which occur during the short-circuit intervals of the above-described test will more or less exactly compensate for the low iron losses (obtained from a no-load test, of course) employed in the calculation of the no load interval.

In conclusion, the writers point out that a great saving in the time taken to test a large generator can be effected by heating the machine up to the maximum temperature it is likely to reach before the commencement of the periodic test. The continuation of this test for an hour or an hour and a half will then, even in the case of the largest generators, allow the steady final temperature to be reached. Such a test is, however, somewhat unfavourable to the machine, for, starting with a cold machine, the temperature is rising asymptotically towards its final value, whilst if the machine is previously heated up, the temperature has to fall asymptotically towards its final value.

ON THE TRAINING OF ENGINEERS AND NATIONAL STABILITY.

By R. BROWNE.

Although the well-being of this country depends principally on engineering, there is not a college or institution in the land where a complete training is given in any one branch of engineering, with the exception, perhaps, of the School of Mines, where, I am told, the student is fully trained, and, if successful in his examinations, leaves the school as qualified to start his work outright as a mining engineer. This, if true, is satisfactory for the young fellow, and for the parents or friends who pay for the training; but how is it with the civil, mechanical and electrical student? Why, it is not only highly unsatisfactory, but is a discredit to the institutions which represent the engineering professions; a discredit to the rich men of the country, especially those who have made their fortunes out of engineering, or those who could not have become rich without mechanical contrivances and engineering skill; and, lastly, a discredit to our statesmen, who should be unceasing in their endeavours to help on our industries and trade by every means possible.

Being a member of any of the engineering institutions does not entitle that member to call himself a qualified engineer, as no certificate of qualification can be given; and the diploma of membership issued by these institutions cannot be considered as carrying any qualifying title. There is, therefore, the greatest possible need for two or three large training colleges, with workshops attached, where a complete training could be given in every branch of engineering; and after about five years of study and work, the qualifying certificate could be awarded, and the student sent forth to make his way in the world. The State, India, and the Colonial manufacturers and other employers would then know where to apply for properly trained men.

We see fathers and mothers stinting themselves of many things for the purpose of educating their sons, and giving them a start in the world; what, therefore, can be more disheartening to them than to find that after they have kept their boys at a technical training college or institution for three or four years, they have then to worry themselves as to where a practical training can be had. A good practical training can be had only in busy engineering firms, or with architects and civil engineers who have work on hand all the year through, but on application to these firms they find to their dismay that no pupils are wanted.

But what do we see at the present time in the electrical engineering profession, and what can be more galling to the parents who spend their last shilling on their sons in order to give them the necessary training? We see in almost every issue of the Electrical Review that about £100 a year, and in many cases much less—less even than some labourers can earn—is the usual salary offered when a shift engineer (another name for charge engineer) is wanted at any of the borough or municipal electricity works throughout the country; and for this pay he is tied up every day throughout the year, with the exception of the very short holiday allowed, which is generally a fortnight or three weeks. Just think of it! for £2 and less a week, Borough and District Councils make it a condition in their advertisements that all applicants for the post of charge engineer must have the necessary technical and practical qualifications, and also some years of mechanical engineering experience. Here we see that skilled and scientific attainments are called for, and only a labourer's pay offered in return. There are, of course, a few corporations which pay their electrical engineers fairly good salaries, but with the exception of these few, the treatment is nothing short of disgraceful. If the electric lighting of towns and running of trams were in the hands of private companies, the pay of the properly qualified electrical engineer would be not less than double what it is now.

There are, at the present time, thousands of well brought-up, well educated young fellows training as best they can for electrical engineering, but they are nearly all ignorant of the miserable prospects before them.

It is of the utmost importance to the public that electrical engineers should be properly trained and qualified men, as unskilled work has been the cause of so many accidents of late to life and property. Is it not time, therefore, that the public were safeguarded by the Board of Trade, and incompetent contracting men and others prevented from calling themselves electrical engineers, and undertaking work which should only be carried out under the superintendence of a skilled electrician?

It is exceedingly mean, unbusinesslike, and bad policy for municipal councils to want to run their electricity works on the cheap at the expense of or by underpaying their engineering staff. But in too many instances it is the municipal chief engineer himself who is to blame for the small salaries given, as he is unprincipled enough not to mind in the least what pay his assistant engineers are receiving, as long as he is himself getting credit for economies and cheap management, which are usually the dearest in the long run, for men inadequately paid take but little interest in their work.

But to be plain, it is not only the engineering staff but the ratepayers who have to suffer in so many towns, owing to the large sums that have been taken in bribes by the promoters of municipal electricity undertakings, and to dishonest management. Clerks of councils who are, with few exceptions, solicitors, appear to have everything in their own hands, and in some places do pretty well as they like, the

chairman and his friends on the council being influenced beforehand as to what business they should carry through at the council meeting; and the clerk and chairman usually get their way. The Holborn frauds and other recent cases ought to be a warning to the public that they should take more interest in municipal management.

The rates at the present time are out of all proportion to the incomes of at least 90 per cent. of the people who have to pay them; is it not, therefore, enough to drive provident men to despair to think that they may soon be called on to feed as well as educate the children of the improvident. The men and women who, through drink and self-indulgence, neglect to feed and clothe their helpless little children are contemptible beyond all words, and a pestilence to their sober and decent living neighbours, as well as to the community at large. Further, it would appear that no man has any right whatever to get up in Parliament or on a public platform and tell other men that a law should be passed to compel the people who work and are thrifty to educate and feed the children of those men who will only work when they think proper, and who when earning good wages will make no provision for hard times.

When times are bad and there are many men and women thrown out of work through no fault of their own, then works of public utility, suitable for men and women, should be started and paid for out of the subscriptions which are always generously forthcoming from the well-to-do people of the empire, at home and abroad, but certainly not out of the rates. In this way the living would be earned, and self-respecting people would be saved the humiliation of receiving charity doles. And what a help it would be if the million and a quarter or so of pounds sterling that leave this country every year for foreign missionary work were annually subscribed for home missionary work, where it is infinitely more needed in this climate of rain and cold.

But I ask all right-minded men, especially men who read the papers, and think sometimes of the general welfare, as well as their own, what do they think is the real cause of the want of steady trade and regular employment? To this question, the answer is, that it is the constantly-recurring trade strikes which are almost wholly the cause of preventing the trade and commerce of the country from being steady and flourishing. Providing that we refused to be unfairly dealt with by other nations, I believe that trade would nearly double in volume, especially if workers in all trades were to free themselves from being the slaves and dupes of trade union despots, and give up strikes as a means of bettering their position.

The big engineering strike of a few years ago did incalculable damage to the whole trade of the country, and business generally has suffered from the effects of it, ever since. If manufacturers and merchants could depend on their workmen, they would soon be in a position to pay good wages, as contracts could be made and fulfilled, and regular orders would be coming in; but business has never time to steady itself before some senseless strike is ordered by the strike masters, and everything is put back again. How, therefore, can there be any stability while the workmen of the country submit themselves to the orders of men, who know in their conscience that strikes will never better the pay or position of the working man or anybody else, and who must also know perfectly well that nearly all the misery now existing in this country has sprung from the paralysing effects of the strikes which have taken place during the last 10 or 15 years? And yet these are the men who have the audacity to go up and down the country stump-speeching the doctrine that industrious men who work all the year round for what they can get, and by their industry keep themselves and their families decent, should be made to pay rates for the support of the families of men who stop work at the time their services are most needed, and remain idle until they are ordered to begin work again. This is what the liberty-loving British workman of the present day has come to. He is no longer a free man to do as he likes, but has to obey the orders of men who are getting their living out of strikes, and by the sowing of discord throughout the land. The injury caused during long strikes to the health of the strikers and their families through bodily suffering, and to their *morale* and welfare generally, can never be repaired, and the money lost in wages is never regained.

Without trade, where would we be? Why, 30 millions out of the 40 millions of the English population would have to go over the seas to find bread, or die for want of it in this country of eternal rains and biting winds, where hardly enough corn can be grown to feed our poultry on. Therefore, unless our trade is maintained and increased as times go on, and our fine ships kept filled with cargoes on their outward and homeward voyages, a decline might set in from which there could be no recovery. But let us keep our star in the ascendancy, and prosper by honest trading, pluck and hardihood, as in the olden days. The honest man, let him be ever so poor, can look the whole world in the face. I cannot believe that my countrymen, English, Scotch and Irish (I am an Irishman myself), will let themselves be beaten in the big world struggle going on for supremacy in trade and commerce; but let us without delay be up and doing, and give up despairing; let men give up whining and poor-mouthed talk, and be men, showing a determination that by honest endeavour they will succeed in their business affairs, keeping in mind always that wealth obtained by unfair means and without work is certain sooner or later to bring a curse or a taint on those who gain it, or on their successors.

The men who gain wealth by successful enterprise and hard work, doing others good as well as themselves, should be esteemed and not envied; in fact, men of this stamp are the salt and mainstay of the country.

When I look at the fine warehouses of the London merchants, and the fine shops of the retailers, I say to myself were it not for these business houses in London and the big towns, the beautiful equipages and horses and other splendours which we see daily would soon disappear from our streets and houses; and yet there are tens of thousands of people, young and old, who, in their supreme conceit and ignorance, speak of trade and tradespeople in the most contemptous terms.

I wish also that our young men would talk less of cricket and football and think more of what good they might be doing their employers, as by helping their employers they would be also helping themselves. I never take any interest in cricket now, for the reason that far too much valuable time is wasted over the game, out of the most useful years of men's lives; and for the reason also that when one side or the other think they are going to be beaten, they do their utmost to drawl out the time so that the game can be declared a draw. It is not sport. The game used to be considered more of a schoolboy pastime, but it is made a business now, by men who ought to know better; and the professional cricketer who can hit up a big score, or screw the ball in on the wickets is talked about as if he were a great hero who is performing splendid services for his country's good. I wonder that some of these men do not exhibit themselves at the public halls, as they would be sure to draw full houses. It is, however, another thing to watch a game of football, played and finished in one afternoon; but I hope we shall not again hear of football matches being played on any days except Saturdays, for the reason that thousands would be drawn away from their work to go and see the play.

There is one subject, which I would respectfully remind the directors of large companies and employers about, and which, I think, deserves their serious consideration. It is the shamefully low salaries they pay to their clerks, and the lack of interest they take in their daily life and personal welfare. In fact, the salaries paid to the majority of young City men are barely enough to pay for the decent clothes they are expected to wear, cheap board, and the season ticket on the railway. In the first place, better salaries ought to be paid where it is possible; and in the second, when there has been a good year's business done, the clerks and warehousemen should be paid a bonus out of the profits. The prospect of a bonus once a year, would encourage men to take more interest in their work and their firm, as it would be like sharing the profits with them; and if all employers were to adopt this system they would find themselves better off at the end of each year. Indeed, I believe that many employers are doing this at the present time.

It is deplorable that there are so many men in almost

every occupation who want to do as they like and as little as they can for their money, having no thought for the interests of the employers who have to find the work and the money to pay them with. This sort of unmanly behaviour is before our eyes every day; and it is only too true that many contractors and employers are driven into bankruptcy owing to their workmen taking a fortnight to do work that might be easily done in a week. This is also a bad sign for the future prosperity of the country, and unless men alter and conduct themselves with more manliness and honesty, employment and pay will become less and less as time goes on.

Of all the sorry and senseless labour demonstrations which have taken place of late, I think the march of the Northampton and Leicester men to London has outdone all. If the labour members of Parliament and the strike masters think that the Government and Parliament can be forced into finding work for the unemployed everywhere, at the expense of the already heavily-taxed ratepayers, they are making a very grave mistake, unless they wish to see the break up of the British Constitution. All that any Government can do is to uphold and further by every means possible the trade interests of the whole country.

Returning to the question of the training of engineers, I remember that a short time ago the governing body of King's College appealed to the public for half a million pounds for the purpose, no doubt, of enlarging the college and equipping it with plant and machinery of all kinds, with the view, I presume, of making it possible for the professors and staff to give a complete technical and practical training in every branch of engineering. Whether the appeal has succeeded to any extent or not I cannot say, but what I can say is that King's College should be backed up, if England wants to retain its world renown for engineering skill and good workmanship. I am afraid that too many well-off Englishmen think only of their own personal comfort, and forget they ought to have a heart and mind to give what help they can to further the general well-being of their countrymen.

When the foregoing was written I had not read Mr. Gerald Balfour's speech on the Unemployed Bill; but now that I have read it, I can only say that it is not within the rights of Parliament to pass a Bill that will rob provident men of their earnings to provide work for the improvident, and for men who are themselves the actual cause of shortage of employment, owing to the employers being unable to depend on their services when there is work to be done. Should this Bill be passed into law, I foresee that a greater mistake for the well-being of the British race will have never been made.

RULES GIVING THE DIRECTION OF ROTATION OF THE FIELD AND ROTOR OF A POLYPHASE MOTOR.

By W. PERREN MAYCOCK.

The following Rules, which have been formulated by the writer, may or may not be of practical utility. They are of some interest, however, as they enable the direction of rotation to be found from simple diagrams of the stator pole-windings and phase polarity-curves, with the pole numbers marked thereon:—

Rule 1.—For a Two-Phase Motor.—*Considering the sign of any pole at an instant when it has definite polarity, whichever pole in the other phase (on either side of it) is "approaching" or "increasing" in the same polarity, will be in the direction of rotation round the face of the stator.*

Rule 2.—For a Three-Phase Motor.—*Considering the sign of any pole in any phase at an instant when it has definite polarity, the nearest pole (on either side of it) in the next phase (taking the order A B C A, &c.) that is of—or "approaching"—the same polarity at that instant, will be in the direction of rotation round the face of the stator.*

In the case of a three-pole machine, there is only one pole in the next phase to consider, and the direction of rotation is then the nearest way round the stator face to that pole.

STREET LIGHTING WITH NERNST LAMPS.

The paper on this subject read before the Municipal Electrical Association by Mr. E. E. Hoadley, borough electrical engineer, Maidstone, was perhaps the best of the lot—certainly the most practical and useful. Mr. Hoadley's experience of the subject, to which he has given special attention, extends over some seven years, and he is to be congratulated upon the considerable measure of success which he has attained. The importance of the subject needs no demonstration; we shall, therefore, proceed to discuss the means adopted by the author to compete with the incandescent gas mantle.

The most satisfactory form of Nernst lamp he finds to be the "A" type, having a vertical glower, and taking ½ ampere at 230 volts, with a luminosity of about 75 c.p. The "B" and "C" types were tried, but abandoned; better results, however, are being obtained with the new "D" type, an improvement on the "B," giving 75 c.p. for about 110 watts. A variation of pressure of 4 per cent. above normal made very little difference in the life of the lamps, and vibration appeared to be equally harmless. The best results were obtained by using a 220-volt burner with a 20-volt resistance on a 230-volt circuit, a conclusion somewhat at variance with the statement that a 4 per cent. rise of voltage did not matter. About 350 of these lamps have been in use in Maidstone for three years, and in actual working it is found that the average life of the lamps is 676 hours, with a tendency to improve. Clear glass globes are used, though prismatic globes give a better light distribution—it being a well-known fact that the British public, in estimating the effectiveness of a lamp, always looks straight at it, instead of turning its back to the light as it should, and is thus more favourably impressed by a brilliant point of light than by a really good illumination. Thirty posts have been fitted with the "D" type, which the author thinks will prove the most useful type for street lighting, but, with commendable caution, he will not commit himself to a definite opinion until he has had a longer experience with this lamp.

It is curious to note that wet weather appears to be detrimental to the burners, for some unexplained reason.

At a distance of 10 ft. from the post, the lamp being 11 ft. high and provided with a reflector, the average illumination is 0·14 candle-foot; the illumination falls off to 0·06 candle-foot at 15 ft., 0·03 at 20 ft., and 0·007 at 40 ft.—figures which compare very favourably with many results obtained by the author from gas mantles in good condition. The author considers that the lamps may be placed 55 yd. apart, against 40 to 50 yd. for gas lamps, and as he puts the annual cost (inclusive) of both gas mantles and Nernst lamps at £3 10s. each, there is evidently a considerable margin of cost in favour of the latter, owing to their wider spacing. The lamp takes 390 units per annum, and has actually cost 9s. for renewals, 10s. for lighting and cleaning, 7s. 6d. for interest and sinking fund (6 per cent. on £6) and 2s. 6d. for repairs and maintenance. The cost of conversion of a post, purchased from the gas company for 30s. and fitted with a swan neck and fitting for £1 19s., and including the lamp, globe, wiring, labour, &c., is £6. The author credits the street lighting with a load factor of 40 per cent., and as the result of long and careful tests, he places the total cost of production of the energy at 0·75d. per unit; with capital charges added, the sum amounts to 1d. per unit, leaving 0·3d. per unit profit.

Mr. Hoadley touches briefly upon the various rivals to the Nernst lamp—mercury vapour, osmium and tantalum—and points out that it is in the lamp that advances must be looked for, as no great reduction in the cost of production can be expected. He thinks that small 100-watt flame arcs with magazine feed are likely to prove the ideal for lighting the less important streets—*when* they become more reliable. It will be seen that, like many other electrical questions, street lighting has by no means approached finality, though it can already be carried on more efficiently than with incandescent gas. There is abundant room for improvement, and the value of the load renders it desirable that every effort should be made to secure the street lighting as a consumer.

NOTES ON COSTS AND TARIFFS FOR ELECTRICITY SUPPLY.

Mr. Kilgour's paper before the Municipal Electrical Association provides a somewhat abstruse answer to a brief question as to "On what do the costs of supply mainly depend?" The author takes the line that these depend, in general, almost entirely upon the *present* liabilities undertaken, and but little upon the actual supply given. His proposition is as follows:—

The liabilities include the provision of the necessary plant, mains, &c., for giving a supply, and also the running of the plant for that purpose.

The capital expenditure and financial charges upon an electric supply undertaking are absolutely determined by the total liabilities undertaken, and are quite independent of whether supply is, or is not, actually given to customers.

The revenue expenditure of an electric supply undertaking is obviously divisible into two distinct parts, viz.: that dependent upon the liability undertaken to give supply, and that dependent upon the extent to which customers avail themselves of their opportunities for taking supply; these are the "cost of getting ready to give supply," and the "running cost" respectively, and the former plus the annual charges on capital is usually called the "stand-by" cost.

The "cost of getting ready to give supply" clearly includes all costs of distribution, of meter reading and maintenance, and of management (in fact, all costs except those of rates and taxes, and of labour and materials employed at the works). It is indisputable also that a part of the works' costs is due to the undertakers' obligation to be always ready to give supply.

The quantity of plant in use, and of labour in attendance thereon, are determined entirely by the expectation of load proper to any given instant, but it makes, in general, very little difference in costs whether the plant runs loaded or light, especially in cases of bad load factor.

The method of determination of the running costs is then discussed; in a modern works with fairly large units the average value of the "running cost" per unit generated should not exceed one-fifth of a penny, unless the circumstances are peculiarly adverse.

The works' "cost of keeping ready to give supply" during a particular period is, of course, the difference between the total works' cost for that period and the total "running cost" of the energy generated therein; in general, it will be found that the ratio of the works' "cost of getting ready to give supply" to the total works' "running cost" for any year ranges from about three to one for a bad load factor and a small output, up to about one to one for a very good load factor and a fairly large output.

The total "cost of getting ready to give supply" includes the corresponding works' cost plus the costs of distribution; and the "stand-by cost" is the total "cost of getting ready to give supply" plus the charges on capital. Obviously, the "stand-by cost" of an undertaking must, in general, be very much larger than its total "running cost."

The annual charges against an undertaking for rates and taxes are totally different in character from any of the costs and charges previously considered, depending presumably on possible trading results, and should be regarded as first charges upon the profits rather than as elements in the cost of working. For this reason it appears correct to take no account of them when considering costs; they have, of course, to be allowed for when settling tariffs.

With reference to the undertaking as a whole, the conclusions arrived at are summarised as follows:

1. The total annual costs are divisible into two distinct parts:—

(*a*) "Stand-by costs," or costs entirely dependent upon liabilities.

(*b*) "Running costs," or costs entirely dependent upon the quantity of energy actually generated.

2. The profits of the undertaking are subject to an annual charge for rates and taxes, and should therefore be at least sufficient to defray this charge.

The author then proceeds to consider the question of charges for energy, suggesting that customers should be grouped into a few distinct classes, when the different supply costs of the different classes can often be approximately ascertained, and a tariff, or set of tariffs, determined, which will ensure that each class pays its supply cost plus the same percentage.

The method of fixing the tariff must include:—

1. The allocation of the energy wasted in distribution, and of the energy used in the works, offices, &c., between the different classes of customers, so that the number of units *generated* for each class—and, therefrom, its total "running cost"—may be known.

2. The allocation of the total capital expenditure between the different classes of customers, so that the annual capital charge proper to each may be known.

3. The allocation of the total "cost of getting ready to give supply" between the different classes of customers.

And, when these allocations have been made, it remains to allocate the annual charge for rates and taxes.

Finally, the author at some length proves that the methods he advocates in the earlier portion of the paper, *i.e.*, deductions from present day costs, are likely to be misleading, and that it is also very necessary to consider future developments in fixing tariffs.

While it is very probable that few have drawn any tangible conclusion from the arguments advanced in the paper, we do not doubt that those who have attempted its digestion could briefly express their opinions in language more forcible than polite.

FREE WIRING AND PREPAYMENT METERS.

The paper read before the M.E.A. by Mr. A. R. Sillar, borough electrical engineer, Colchester, on the advantages of electricity supply on the system above named, was intended for the edification of those of his brother engineers who despised it or would not be worried with it. The author had evidently gone into the business with an amount of energy which compelled success, and he spoke highly of the results, both direct and indirect.

Mr. Sillar makes some quaint observations on the class of consumers obtained. Old houses rented at 5s. 6d. a week inclusive yield no takers, whereas houses five or ten years old, letting at 7s. a week, rise freely to the bait. The best type is the house with six rooms, and it doesn't matter whether there is an entrance hall or not!

It is certainly interesting to note that many men earning not more than £1 a week are customers; evidently electricity is already the poor man's light, in Colchester.

The author gives full details of his mode of operation in securing consumers. He fits any desired number of lamps in business premises, with reasonable prospects of use; in private residences, however, only four lamps are installed free, one of these being in the hypothetical entrance hall, to encourage the others, and further lamps may be fixed for 8s. each. Every 40 units consumed entitles the consumer to one new lamp free. The agreement is very simple, to avoid frightening would-be consumers.

We are pleased to note that the wiring is done by a local contractor, in batches of 50 installations. The cost works out at 35s. per house, + 4s. for the lamps. The service cable is looped into several cottages, and costs, with joint box, meter, labour, &c., £4 19s. 3d. on the average.

The meter is the most expensive item; the author says get a good one, though it costs more. He prefers the mercury type to the motor type, but is evidently not satisfied with any at present in use. Sticking of the motor, or of the coin, is a great trouble with these meters. Three times as many shilling-in-slot meters as penny meters are called for. The best class of lamp to use is a first-class "4-watt" lamp.

The charge in Colchester until April last was 6d. per unit, compared with 5d. to ordinary consumers. In April the prices were reduced respectively to 5½d. and 4½d., the difference, 1d. per unit, being applied to the repayment of cost of the installations. The meters are visited every three months in the summer, and every month in the winter.

Discussing the financial results, the author gives two tables of considerable interest; we therefore reproduce them in full. The total cost for generation and distribution in

Colchester last year was 1·70d., and the capital charges were exactly 1d. per unit. The cost of meters, services, &c., for "slot" consumers was more than six times as much per lamp as for ordinary consumers, namely, 11s. 3d. per 8-c.p., compared with 1s. 11d. The cost of the installation is to be written off in five yearly instalments of 20 per cent. each.

Table A.

Number of consumers, 82.
Units supplied, 7,433.
Units sold per consumer per annum, 90·6.
Amount received per consumer per annum, £2 5s. 4d.
Average cost of installation, complete with lamps, £2 8s. 1d.
Average cost of meter, terminal box, and service cable fixed, £4 19s. 3d.
Average cost of meter, &c., per equivalent 8-c.p. lamp, 12s. 3d.
Average cost of meter, terminal box, service cable, &c., to the ordinary consumer per equivalent 8-c.p. lamp, 1s. 11d.
Number of lamps actually connected, 422.
Number of equivalent 8-c.p. lamps, 665.
Number of lamps connected per consumer, 5·14.
Number of equivalent 8-c.p. lamps connected per consumer, 8·11.

Table B.—Revenue.

90·6 units at 6d. per unit	£2	5	4

Expenditure.

Cost of generation and distribution, 90·6 units at 1·7d.	0	12	10
Standing charges on 90·6 units at 1d. per unit	0	7	6
Repayment of installation at the rate of 20 per cent. on £2 8s. 1d....	0	9	7
Additional interest and sinking fund on slot meters and service mains at 6½ per cent. on £4 4s. 6d....	0	5	6
Cost of lamp renewals at 4 per cent. of the revenue ...	0	1	9
Net profit per installation...	0	8	2
Total	£2	5	4

The author naively remarks that whereas some towns have obtained special permission from the Local Government Board to raise loans for free wiring, he has managed to pay for his system by means of an overdraft at the bank!

After the cost of the installation is paid off in five years, the net profit per installation (so long as it lasts) will rise to 17s. 9d. per annum. In conclusion, the author repeats that this class of consumer is well worth catering for, if only for the sake of competition with the gas department, and of the excellent advertisement obtained.

EXTENSIONS TO OUTLYING AREAS.

Mr. A. B. Mountain, borough electrical engineer, Huddersfield, read a paper at the Municipal Electrical Association Convention on this subject, dividing it under two heads—that of policy, and that of engineering. Alluding to the enormous development of municipal work (to which he might have added municipal debt) during the past 30 years, and the effect of electric traction in spreading population over a larger area, the author pointed out that the latter carried the disadvantage of reducing the rateable value of the central area and increasing that of the outer areas. Allowing for the time occupied in transit, the practical limit of expansion of the residential area was placed at about five miles from the central area. In the author's view it was the duty of the central authority to extend its electric supply mains into the surrounding districts, if there were any likelihood of these becoming eventually incorporated within the boundaries of the central authority; but if this were not the case, the matter became a question of municipal trading, and must be considered upon purely business lines.

The price to be charged for energy supplied to external districts was difficult to fix; it might be uniform over the whole area of supply, were it not for the fact that the cost of mains to the outlying districts was greater than in the central portion of the area. Generally an addition of 10 per cent. would suffice, and it was doubtful whether this could be exceeded without exceeding the cost of a local supply. Steps should be taken at once, if at all, to supply such areas; otherwise the neighbouring Power Co. would forestall the municipality. It will be seen that the shadow of the Power Co. has fallen upon Mr. Mountain, as well as upon Councillor W. Hodgson.

Turning to the engineering aspect of the question, the author suggests, as the most suitable system for supplying districts within 5 miles of the centre of the town, high-pressure alternating-current, single or polyphase, fed to the centre of each village by underground mains, transformed and distributed by overhead conductors. The author has found that the average cost of connecting consumers with underground mains is about £7 each, whereas with overhead wires the cost is only £4, including meters and fuses in both cases. Overhead mains cost only half as much as underground, are easily extended or removed without loss, increased in section, and maintained in good order. "At present, however, the feeling against overhead mains seems so strong that it is only possible to obtain consent for their erection in the more enlightened areas." This is an admirable statement of the actual facts, and we heartily endorse it.

The author views with disfavour bulk supply to a district council, with distribution by the latter: it is bound to increase the cost of supply.

Low pressure, low price, and the use of prepayment meters are essential to success in supplying small houses.

An improvement in the load factor, in the author's opinion, would result from supplying the outer areas, from several causes.

The author concludes with analyses showing the comparative cost of supplying from a small village installation and from a central area, respectively, basing his figures upon an actual case recently carried out by him. The local installation is of 68-kw. capacity, and is, of course, gas-driven; overhead wiring is used. The capital outlay for 80 consumers and 40 street lamps amounted to £3,000, whereas the central authority would have had to spend £4,300, or, with underground distributors, £5,350. The cost of supply from the local plant was 4·41d. per unit, and from the central station 4·09d. with overhead wires, 4·85d. with underground conductors, which thus made a difference of ·75d. per unit. Evidently there is much to be said for the small local plant.

Electricity in Mines.—Mr. Hall, one of H.M. Inspectors of Mines, at a recent meeting of the Manchester Geological and Mining Society, called attention to Mr. Holliday's paper read before the North of England Institute of Mining and Mechanical Engineers, with reference to the ignition of coal dust by electric lamps. Mr. Holliday had had a fire in his colliery, with which he suspected the electric lights had some connection. This led him to make experiments, which, as appeared from his paper, confirmed his suspicions. Mr. Hall said it had usually been held that electric lamps gave off very little heat, and that they might be placed almost anywhere with safety. This impression Mr. Holliday had proved to be quite erroneous. "He shows there is considerable danger from fire, and also from the exposure for an instant of an open light when the lamp bursts. I have repeated Mr. Holliday's experiments, and the results bear out entirely what he has stated. I found that when a 16-candle lamp either rested uncovered on coal dust, or partially covered, heat was generated very rapidly. In one case, with a slight covering of dust, the temperature rose in 10 minutes to 370° F., and in 21 minutes the lamp exploded at a temperature of 450. The highest temperature registered was 650°. In two out of three experiments the coal dust was found to be red-hot on poking into the dust, although the lamp—the apparent source of heat—had been removed some time. The interesting part of these experiments seems to be that when the dust has been raised to a certain temperature, the action of spontaneous combustion begins to operate, and the temperature goes on increasing till fire is reached, although the lamp has been removed. These phenomena show that, unless care is used in the placing of electric lights underground, there will be danger of underground fires and some danger of fire-damp being ignited by the explosion of a lamp. The experiments will be carried further with the view of finding what is the temperature at which coal dust will begin to develop spontaneous combustion."

Improper Parliamentary Tactics.—Every duly-qualified citizen of London has his Parliamentary vote, yet, says a correspondent, it seems to us, and the impression is strengthened by the action of certain London County Councillors who have seats in Parliament, that the L.C.C. expects London to have a double representation, first, by its lawfully-elected members, and, secondly, in a corporate sense through members who speak in the House not as members of the House so much as members of an outside body. It is time that a stop was put upon such abuses. Why should the time of the House be wasted in listening to the outpourings of men who speak as County Councillors, and endeavour to forward, not the interests of London, but the ideas of the County Council, which are making for municipal extravagance and bankruptcy?

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

16,038A. 1904. "Central exchange telephone systems." B. VRANDA. (Date applied for under Patents Rule 9, July 20th, 1904). June 28th.

13,140. "Improvements in and relating to electric arc lamps." A. W. HILL and THE SIR HIRAM MAXIM ELECTRICAL CO., LTD. June 26th.

13,150. "Microphonic diaphragm coupling for phonographs, gramophones and others." M. MONDRAGON. June 26th. (Complete.)

13,154. "Improvements in or relating to scouring and plating machines." L. GROTE. (L. Schulte, United States.) June 26th.

13,156. "Improvements in automatic electric switches." H. BIRKBECK. (The Phelps Co., United States.) June 26th.

13,158. "Improvements in or relating to electric lamps of the character known as vapour lamps, in part applicable to other electric vapour apparatus." C. O. BASTIAN and G. CALVERT. June 26th.

13,163. "Improvements in electric machines." W. A. JOHNSON. June 26th. (Complete.)

13,182. "Improvements in electric switching apparatus." F. M. LEWIS. June 26th.

13,227. "Improvements in and relating to electrical lighting or heating devices, other than crucibles." F. W. V. FITZGERALD and H. S. REVELL. June 27th.

13,228. "Improvements in telephone or like transmitters." J. S. SAWREY. June 27th.

13,235. "Improvements in and connected with electrically and otherwise propelled tramcars, omnibuses, and other road vehicles." G. S. THOMPSON and M. M. THOMPSON. June 27th.

13,252. "Improvements in magneto-electric machines for use in connection with ignition devices of internal combustion engines." H. DE LA VALETTE. June 27th.

13,298. "Improvements in electric automatic cut-outs with time lag element." E. W. COWAN and W. P. HAMLYN. June 28th.

13,327. "Improvements in responders for wireless telegraphy." W. J. HANCOCK. June 28th. (Complete.)

13,332. "Improvements in swivelling trolley heads, current collectors and the like." P. T. J. ESTLER. June 28th.

13,346. "A device for testing or detecting electrical sparking." F. E. SMITH. June 28th. (Complete.)

13,378. "Improvements in thermal electric cut-outs." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 29th. (Complete.)

13,379. "Improvements in dynamo-electric machines." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 29th.

13,380. "Improvements in systems of electric control and apparatus therefor." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 29th.

13,381. "Improvements in electrodes for electric arc lamps." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 29th. (Complete.)

13,382. "Improvements in systems of motor control." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 29th. (Complete.)

13,383. "Improvements in and relating to electric conductors." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 29th. (Complete.)

13,384. "Improvements in and relating to electric conductors." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 29th. (Complete.)

13,394. "Improvements in or connected with telephone apparatus." C. J. MONTGOMERY. June 29th.

13,424. "Lamp sockets." W. FAIRWEATHER. (The Benjamin Electric Manufacturing Co., United States.) June 29th. (Complete.)

13,425. "Cluster lamp sockets." W. FAIRWEATHER. (The Benjamin Electric Manufacturing Co., United States.) June 29th. (Complete.)

13,427. "Improvements in secondary batteries." I. KITSEE. June 29th. (Complete.)

13,430. "Improvements in coin-freed apparatus for the supply of gas, electricity and the like." J. M. TOURTEL. June 29th.

13,464. "Improvements in and relating to wireless telegraphic apparatus." A. ARTOM. June 29th.

13,471. "Improvements in and relating to accumulator grids and moulds therefor." H. W. COX, LTD., and A. C. MITCHARD. June 29th. (Complete.)

13,482. "Improvements in and relating to electric switches with enclosed fuse." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 29th.

13,483. "Improvements in electric arc lamps." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 29th.

13,496. "Hygienic telephone attachment." H. J. F. CROSBY. July 1st.

13,509. "An improved electric lamp for advertising and other purposes." A. M. LEHFELDT. July 1st.

13,531. "Improvements in electric drills." J. TAUFNEH and P. OBERWEIS. July 1st.

13,558. "Plug switch." P. J. GREAVER. July 1st.

13,563. "A new or improved electric ignition device or sparking plug for internal combustion motors." C. O. BASTIAN and G. CALVERT. July 1st.

13,569. "An improved telephone attachment." D. C. DAVIES. July 1st.

13,577. "Improvements in or relating to electric hoists suitable for use on warships." CLARKE, CHAPMAN & Co., LTD., and H. WALKER. July 1st.

13,586. "Improved method of and means for supplying current to branch stations of telephone exchanges." SIEMENS BROS. & CO., LTD. (Siemens and Halske Akt.-Ges., Germany.) July 1st. (Complete.)

13,587. "An improved starting switch for three-phase electric motors having a resistance in series with the rotor." SIEMENS BROS. & CO., LTD., H. BERRY and C. M. TOPLIS. July 1st. (Complete.)

13,588. "Improvements in dynamo-electric machines." SIEMENS BROS. AND CO., LTD., and H. BERRY. July 1st. (Complete.)

13,589. "Improved method of and apparatus for cooling commutators of dynamo-electric machines." SIEMENS BROS. & CO., LTD., and H. BERRY. July 1st. (Complete.)

13,590. "An improvement in electric switches for coin-freed mechanisms time switches or the like." SIEMENS BROS. & CO., LTD. (Siemens Schuckertwerke G.m.b.H. Germany.) July 1st. (Complete.)

13,597. "Improvements in steriliser mouthpieces for telephones and the like." O. H. SAVAGE. July 1st. (Complete.)

13,605. "Improvements relating to telegraphic systems." P. PICARD. (Date applied for under Patents Act, 1901, December 27th, 1904, being date of application in Belgium.) July 1st. (Complete.)

Thornhill Electric Lighting.—The Yorkshire Electrical Distribution Co., Ltd., is applying for E.L. powers for the district.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

ELECTRIC TRAMWAYS WORKED ON THE CONDUIT SYSTEM. W. J. A. Watkins. 14,195. June 23rd.

DYNAMO-ELECTRIC MACHINES AND THE LIKE. L. Torda. 14,250. June 23rd.

INSULATING ELECTRIC CONDUCTORS ESPECIALLY SUITABLE FOR THE FIRING PLUGS OF INTERNAL COMBUSTION ENGINES. J. Leighton and E. Hacking. 14,717. June 30th.

CONTROL OF ELECTRIC MOTORS AND MACHINES DRIVEN THEREBY. British Thomson-Houston Co., Ltd. (General Electric Co.) 15,070. July 5th.

ENCLOSED ELECTRIC FUSES. British Thomson-Houston Co., Ltd. (General Electric Co.) 15,393. July 9th.

DYNAMO-ELECTRIC MACHINES FOR REGULATING THE CHARGE AND DISCHARGE OF STORAGE BATTERIES USED IN COMBINATION WITH MAIN GENERATORS. Lancashire Dynamo and Motor Co., Ltd., and R. S. McLeod. 15,495. July 12th.

ELECTRICAL RESISTANCES. Veritys, Ltd., and Gott. 15,548. July 14th.

ALTERNATING ELECTRIC CURRENT METERS. Allgemeine Elektricitats-Ges. (Date applied for under International Convention July 17th, 1903.) 15,879. July 16th.

VAPOUR ELECTRIC APPARATUS. E. A. Carolan. (General Electric Co.) 16,026. July 19th.

REVERSE ELECTRIC CURRENT SWITCHES OR CIRCUIT BREAKERS. British Thomson-Houston Co., Ltd. (General Electric Co.) 16,109. July 20th.

ELECTRIC ARC LAMPS. J. Brockie. 16,241. July 22nd.

ELECTRIC CONTROLLERS. British Thomson-Houston Co., Ltd. (General Electric Co.) 16,260. July 22nd.

ELECTRIC COUPLINGS. W. C. Lea. 16,340. July 23rd.

ELECTRIC MEASURING INSTRUMENTS. British Thomson-Houston Co., Ltd. (General Electric Co.) 16,409. July 25th.

ELECTRIC AUTOMATIC STOP MOTION FOR LACE MACHINES. Mills. (A. Pocheron, F. Cellery & Co.) 16,746. July 29th.

ELECTRIC GOVERNOR FOR INTERNAL COMBUSTION ENGINES. G. A. E. Roberts. 17,133. August 5th.

SWITCHING DEVICES FOR ELECTRIC LAMPS ESPECIALLY ADAPTED FOR USE IN "FLASH" ADVERTISING. L. K. Job. 29,125. December 30th.

TELEPHONIC SPEAKING SYSTEMS. G. C. Dowing. (M. Gally, U.S.A.) 3,323. February 10th.

MOTORS AND GENERATORS. The British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 8,403. April 12th.

CONTROLLERS FOR THE MOTORS OF ELECTRICALLY-PROPELLED VEHICLES. M. Cummins. 8,501. April 13th.

ELECTRICITY METERS. R. C. Griesbach. 10,502. May 6th.

TRANSMITTING POWER ELECTRICALLY AND CONTROLLING SAME. The British Thomson-Houston Co., Ltd. (General Electric Co., Ltd.) 10,880. May 11th.

ELECTRIC METERS. The British Thomson-Houston Co., Ltd., and F. Holden. 10,882. May 11th.

RAIL AND TRAMWAY SIGNALLING SYSTEMS. The British Thomson-Houston Co., Ltd. (The General Electric Co., Ltd., U.S.A.) 11,074. May 13th.

CONTROLLING THE MOVEMENTS OF A CAGE WORKING IN A LIFT OR HOIST OR OF A CAR TRAVELLING ON AN INCLINED OR OTHER RAILWAY. E. S. W. Moore and W. B. Bennitt. 11,121. May 14th.

MAGNETO-ELECTRIC GENERATORS. Albion Motor Car Co., Ltd., and T. B. Murray. 11,880. May 25th.

THERMAL CUT-OUTS FOR ELECTRIC CIRCUITS. The British Thomson-Houston Co., Ltd. (General Electric Co., Ltd., U.S.A.) 12,337. May 31st.

ARC LAMP ELECTRODES. W. S. Weedon. (Date applied for under International Convention, April 21st, 1903.) 9,190. April 21st.

ELECTRIC CONTROL SYSTEMS. The British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 10,459. May 6th.

VAPOUR ELECTRIC APPARATUS. F. W. Le Tall. (The Cooper-Hewitt Electric Co., U.S.A.) 10,672. May 9th.

ELECTRO-MAGNETIC APPARATUS FOR OPERATING RAILWAY SIGNALS AND POINTS. E. W. Timmis. 10,962. May 12th.

METERS. C. W. Atkinson. 11,093. May 13th.

COUNTER-WEIGHTS FOR ELECTRIC LIGHT FITTINGS. H. Hirst and J. H. Callings. 11,284. May 17th.

ELECTRO-MAGNETIC SELECTING OR DISTRIBUTING DEVICE FOR USE IN TYPE DISTRIBUTING AND OTHER MACHINES. P. Wagner. 11,638. May 20th.

LIGHTING RAILWAYS BY ELECTRICITY. H. Wright. 11,842. May 24th.

APPARATUS FOR MOUNTING AND COOLING STATICAL OZONIZERS. Compagnie Francais de L'Ozone. (Date applied for under International Convention, November 20th, 19 3.) 12,060. May 27th.

WELDED CONDUITS FOR ELECTRIC WIRING. T. Taylor. 12,136. May 28th.

SWITCHES. The British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 12,338. May 31st.

INSULATING MATERIAL. A. Geipel. 13,158. June 10th.

RADIATORS. H. J. Dowsing. 13,180. June 10th.

CELL LID FOR ACCUMULATORS ON BOARD SHIP AND MOTOR CARS. A. A. Smethurst and T. H. Bishop. 14,087. June 22nd.

APPARATUS FOR ELECTRICALLY-OPERATING BULKHEAD DOORS, HATCHES, OR THE LIKE. A. P. Jones. (The "Long Arm" System Co., U.S.A.) 20,351. September 21st.

BATH FOR THERAPEUTIC TREATMENT BY MEANS OF ELECTRIC AND OTHER FORMS OF RADIANT ENERGY. W. J. Smyth. 20,536. September 23rd.

ENCLOSED DYNAMO-ELECTRIC MACHINES. R. M. Newbold. 23,612. November 1st.

COOKING AND HEATING APPARATUS. The British Prometheus Co., Ltd., and A. S. Cubitt. 12,214. May 30th.

SWITCHES. F. H. de Veulle. 12,418. June 1st.

ELECTRIC CONDENSERS. The British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 13,072. June 9th.

RAIL BONDS. The British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 13,275. June 11th.

COIL WINDING FOR ELECTRICAL APPARATUS. The British Thomson-Houston Co., Ltd. (General Electric Co., Ltd., U.S.A.) 13,277. June 11th.

MECHANICAL EAR USED FOR THE SUSPENSION OF OVERHEAD TROLLEY WIRES. W. E. Taylor. 13,516. June 15th.

CONTROLLERS. The British Thomson-Houston Co., Ltd. (General Electric Co., Ltd., U.S.A.) 13,509. June 15th.

ALARM CLOCKS. F. W. Baynes. 13,596. June 16th.

HANDLE FOR ROTARY HAIR BRUSHES AND OTHER DEVICES DRIVEN BY ELECTRICITY. J. MacLean. 13,623. June 16th.

CLOCKS CONTROLLED BY REVERSALS OF ELECTRIC CURRENT. F. W. Howorth. (The Firm Magneta Fabrik Elec. Uhren.) 13,686. June 16th.

ELECTRICAL TRACTION OVERHEAD CONDUCTOR EQUIPMENT. C. A. Schierwater. 13,720. June 17th.

DYNAMO-ELECTRIC MACHINES. The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitats Gesellschaft, Germany.) 13,864. June 18th.

PRELIMINARY TREATMENT FOR ELECTRIC ACCUMULATOR PLATES. H. Leitner. 14,198. June 22nd.